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Correlation of the X-Ray Diagnosis with the Operative Findings in Small-Intestinal Obstruction

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WHILE ADEQUATE recognition is given to the early radiological investigation of lesions in the stomach, duodenum, and colon, the value of this procedure in small-intestinal obstruction is overlooked. This is due probably to the stress that has been placed upon the former at the expense of the latter. So important is the x-ray in the early diagnosis of intestinal obstruction that emphasis should be placed repeatedly upon its use.

In the stomach and colon the gas is more or less free and its distribution is demonstrable as a shadow on the film; in the small bowel the gas is distributed and intimately mixed with the bowel contents and cannot normally be shown by radiologic study. Its demonstration is indicative of bowel interference and is of pathological significance. It presents a shadow early in obstructive lesions of the small bowel which is of great diagnostic value.

Although gaseous shadows in the small bowel have been known for over thirty years to be of some importance as an indication of disturbed motility, the profession is still not sufficiently impressed with their diagnostic value to institute an early radiological study in small bowel obstruction. Schwarz, in 1911, called attention to the gaseous shadows seen in the small bowel in obstructive lesions and indicated their significance. He advised the use of an opaque medium as a confirmatory diagnostic agent. In 1914 Case described gas shadows in the small bowel as a diagnostic aid in obstruction. Kloiber, in 1919, was the first to state that the diagnosis of small-bowel obstruction could be made by the gaseous shadows on an x-ray negative, and that a contrast medium was not necessary for confirmation. He demonstrated that gas shadows in the small bowel were abnormal and indicative of obstruction.

The typical transverse pattern, described by Case, is not necessary for a diagnosis of small-bowel obstruction. A collection of gas in the small bowel in the adult may be considered as synonymous with obstruction. In very small children, gas may be seen in the small bowel and be of no diagnostic significance. The collection of gas after obstruction is not a late development; it is seen soon after the onset of the obstruction, usually being demonstrable without difficulty in four or five hours. The distribution of the gas in the small intestine is indicative of the probable type of lesion. In simple obstruction, it may be centrally located, with a transverse long axis; in loop obstruction, the dilated loops may assume no definite pattern, and proximal bowel distention is slow in developing. If the walls separating loops are thick, it

[1] Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–2, 1943.

Fig. 1. Case I: Distention of coils of small intestines, indicating obstruction.

Fig. 2. Case II: Typical distention in obstructive lesion of small intestines.

signifies the presence of fluid or exudate. Collections of gas in the large intestine are quite in contrast to collections in the small bowel, in that the long axis is vertical, the bowel wall is thicker, and haustral markings are present. The step-ladder appearance of small-bowel distention indicates advanced obstruction and is associated with a variable degree of abdominal distention. The gas is present and can be demonstrated long before distention and this particular pattern develop. Thus it may be said fairly accurately that the x-ray can make an early diagnosis of small-bowel obstruction, and that it can demonstrate the distribution of gas and the location and probable nature of the obstruction.

From an abdominal roentgenogram, one can readily determine whether the distention is in the large bowel or the small bowel. If it is in the large bowel, there is usually a closed loop obstruction, the ileocecal valve preventing regurgitation into the ileum. If it is in the small bowel, the type and character of the distention depend upon the nature of the obstruction, and from the pattern of distention the urgency of the situation becomes apparent.

In postoperative distention there may be a question as to whether a mechanical obstruction is present or a paralytic ileus is the causative factor. In the former event, the small intestines are obstructed, while in the latter there is distention of both the small and large bowel. A radiographic film shows the nature of the gaseous distention and distinguishes between the two conditions. If the obstruction is mechanical, the small bowel is distended and the colon is empty; in ileus, gaseous distention is present in both the small and large bowel. Repeated films may be necessary to determine the certainty of an ileus. Consideration must also be given to the presence of a so-called silent and painless abdomen as a differential point in diagnosis.

A simple adhesive band producing proximal distention of the bowel results in no immediate vascular damage, and operation

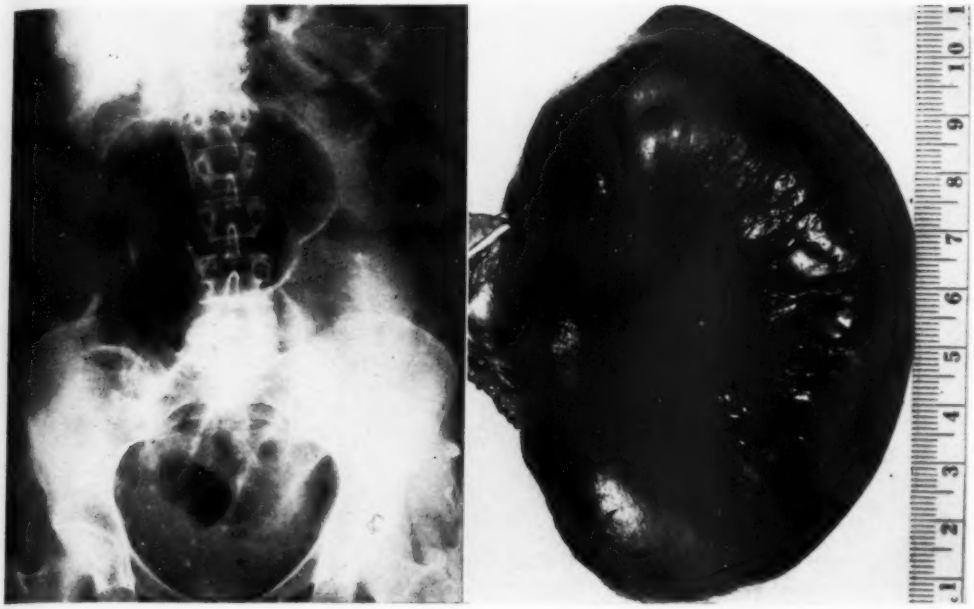

Fig. 3. Case III: Loop obstruction secondary to volvulus. Roentgenogram and operative specimen (metric rule).

may be deferred until rehabilitation of the patient can be accomplished and intestinal decompression established. A loop obstruction, volvulus or strangulation, on the other hand, demands immediate operative interference because of the danger of devitalization and bowel gangrene. With such obstruction, the bowel is not observed assuming the transverse position, but forming one or more distended loops, with no set pattern and with little or no proximal distention until the obstruction has been present for some hours. The reason for the delay in distention of the proximal bowel is not understood, but it is probably due to the associated hyperemia and edema. Wangensteen mentions the altered state of the bowel proximal to the infarcted loop as a partial explanation.

The simple adhesive obstructions are probably the most common types involving the small intestines, and their presence can be detected early by radiological study. The pattern is characteristic, and the sequelae of loss of electrolytes and of body fluids and distention are in relation to the extent and level of the obstruction.

CASE I: M. I. entered the hospital with abdominal pain, periodic in character, and with moderate distention. Little or no fluid loss from vomiting had occurred. A recent operation had been performed elsewhere for an acute appendicitis. Recovery had been uneventful, without protracted hospitalization or abdominal drainage.

Obstruction was suspected because of the nature of the complaints, the absence of symptoms indicating any other type of colic or localized inflammatory process, and the presence of an abdominal operative scar, which always adds weight to the suspicion of small-intestinal obstruction. An x-ray film (Fig. 1) revealed obstruction of the distal portion of the small bowel with only moderate proximal bowel distention. Favorable systemic and local conditions warranted immediate operation, which corroborated the x-ray diagnosis of small-bowel adhesive obstruction. The terminal ileum was constricted and angulated by a band of adhesion. Recovery was uneventful.

CASE II: A similar condition is shown in M. H., a girl of 13 years who, six weeks previously, had an appendectomy for acute appendicitis, accompanied by drainage. Abdominal pain suggestive of obstruction prompted an x-ray study of the gaseous distribution in the intestinal tract. This readily revealed a simple obstructive lesion of the terminal small bowel (Fig. 2). Again operation corroborated the x-ray diagnosis. Recovery was prompt after an adhesive obstruction 6 or 8 inches from the cecum was freed.

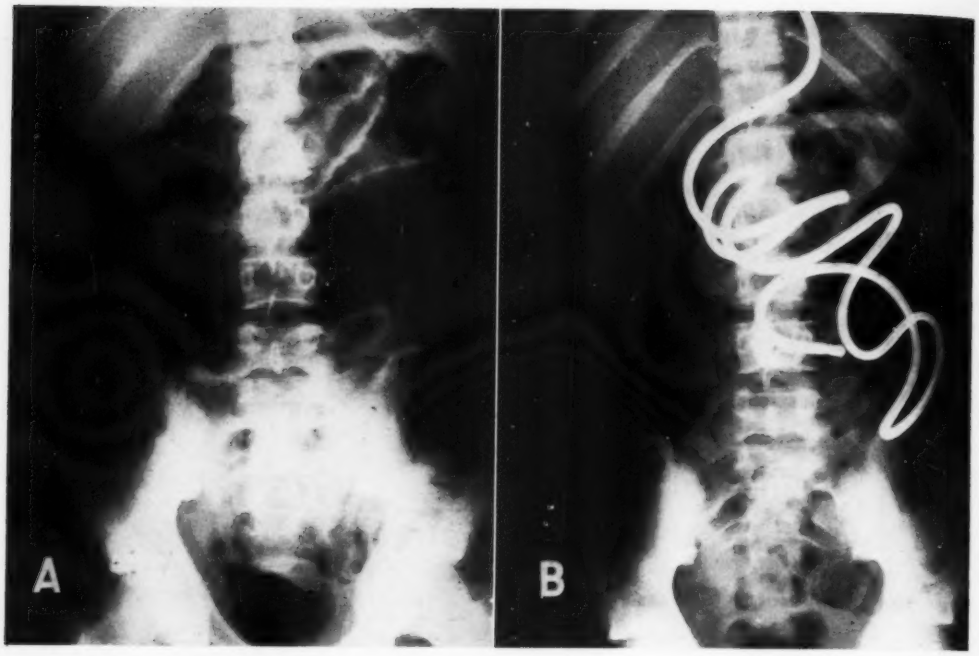

Fig. 4. Case IV: A. Distention of coils of small bowel nineteen days following operative procedure. B. Deflation of small intestines by use of a Miller-Abbott tube.

CASE III: Figure 3 shows the pattern of intestinal gas in a middle-aged woman, S. B., who had previously had a panhysterectomy for a fundal carcinoma of the uterus. The x-ray diagnosis was a loop obstruction of the small intestine, without proximal bowel distention, and immediate operation was advised. The possibility that obstruction was due to metastatic cancer was considered. At operation a loop obstruction with volvulus and gangrenous bowel, adhesive and benign in character, was found. Resection with side-to-side anastomosis was followed by a normal convalescence. The operative findings confirmed the radiological diagnosis. The resected specimen is shown in Figure 3.

Small-bowel obstructions frequently occur in association with inflammatory lesions within the abdomen and usually present the characteristic pattern of a progressive proximal bowel distention in which the viability of the bowel is not in jeopardy. In this type of obstruction it is not often necessary to interfere surgically, as the condition results from localized inflammation and edema which narrow and constrict the adherent bowel to the point of obstruction. The constriction will usually disappear, and the bowel again become patent, if the patient can be carried along by intestinal intubation and such rehabilitation methods as administration of fluids and salines and transfusion until the inflammatory process has subsided.

Surgery is attended by great danger to the inflamed edematous bowel and may lead to extension of the infection. Intestinal decompression by the Miller-Abbott tube reduces distention and lessens the edema and hypertrophy proximal to the obstruction. With intubation and appropriate systemic measures, recovery will occur without resort to surgery. Enterostomy is not required, as a more effective decompression measure is found in intestinal intubation. Enterostomy is ineffective, since it drains only a limited segment of the bowel or a few distended loops and has many hazards.

CASE IV: This case illustrates the value of conservative decompressive measures. W. H., a 16-year-old boy, presented the picture of an acute

abdominal condition of several days' duration. The abdomen was board-like but not distended; the pulse was fast; the temperature was elevated 3 degrees; the white blood count was 20,000. The patient was dehydrated and in very unfavorable condition for immediate surgery. Since it had been several days since the onset of the acute process, and because of the poor condition of the patient, conservative measures were followed. A mass developed and subsequently a large appendiceal abscess was surgically drained. Convalescence was stormy but progressive until the 19th postoperative day, when abdominal pain, periodic and cramp-like in character, developed. Diffuse abdominal colic was followed by vomiting. Obstruction was suspected, and a film of the abdomen (Fig. 4A) showed rather extensive distention of the small bowel. A diagnosis of obstruction of the small intestines was made, due to proximity of the gut to the inflammatory process. The use of the Miller-Abbott tube (Fig. 4B), adequate fluids, saline, glucose, and blood transfusions resulted in complete recovery after a secondary abscess spontaneously drained through the operative incision. After forty days of hospitalization convalescence was complete, and the patient was discharged.

External strangulation obstruction in the nature of hernia usually requires no x-ray study, as the patient seeks medical aid early and the diagnosis is made before abdominal distention occurs. Occasionally an obscure hernia within the abdomen arouses the suspicion of intestinal obstruction and is confirmed by a radiographic film. The picture is similar to that of a simple obstruction, with the added danger of segmental bowel gangrene.

CASE V: This recent case shows the possible danger of bowel gangrene in an apparently simple obstruction. The patient, F. P., 67 years of age, gave no history of previous intestinal disorder and had undergone no abdominal surgery. The radiograph (Fig. 5) demonstrated gaseous distention of the small bowel of the simple obstructive type. Operation revealed a Richter's hernia of the small bowel into the femoral canal. The segment of bowel involved was viable and recovery was without difficulty.

In patients of advanced years in the absence of previous abdominal surgery, the possibility of a colonic lesion must be given careful consideration. This can be most effectively determined by barium enema. Such a lesion being excluded, some variety of internal hernia must be considered.

Fig. 5. Case V: Gaseous distention indicating obstruction due to a Richter's hernia.

Intussusception presents two avenues for profitable use of the x-ray. First, it is most valuable in confirming the diagnosis suspected from the passage of blood and mucus in the stools of an infant or small child who has abdominal colic and a palpable mass. Second, it is the only guide by which one may be certain of reduction by non-surgical means. Only with the aid of a thin opaque enema can complete reduction be determined. Reduction may appear to be successful when in reality a segment at the ileocecal valve may remain intussuscepted. The completeness of reduction can be determined only by use of an opaque medium which shows the entire outline of the colon and cecum.

Figure 6 (Case VI) shows an intussusception before reduction by barium enema (A) and illustrates the completeness of reduction as demonstrated by a well-visualized cecum (B). Figure 7 (Case VII) shows an intussusception of the ileum into the splenic flexure, requiring surgical reduction.

The clinical history of the obstructed

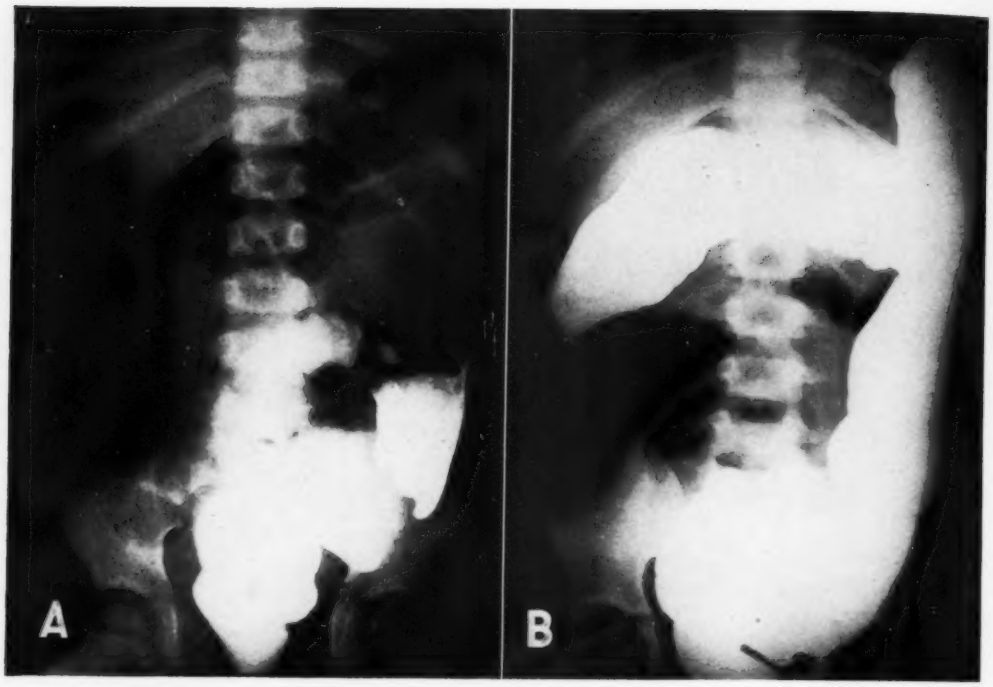

Fig. 6. Case VI: A. Changes in the contour and outline of the opaque column indicating intussusception. B. Intussusception completely reduced.

patient is as essential to proper interpretation of the film by the radiologist as it is to the surgeon. A co-operative exchange of information is essential and helpful to both. The radiologist must associate the clinical history and physical findings with the radiographic picture. He must therefore evaluate the symptoms and signs of small bowel obstruction. While intestinal obstruction presents few or no early physical signs, their very absence indicates that there is no localized process in any of the four quadrants of the abdomen. The colic is diffuse and periodic and differs from any other form of abdominal colic, which is usually localized in character and constant and continuous in type. Abdominal rigidity and localized tenderness are not present as in an acute inflammatory process involving the appendix or gallbladder, or a perforated duodenal ulcer. The pain comes in paroxysms, with intervals of relief. Peristalsis may be seen over the abdomen during the spasms of pain, and auscultation may reveal the increased sound of intestinal contractions. The abdomen presents a noisy rumbling sound during these paroxysms—borborygmus.

It must be remembered, as emphasized by Wangensteen, that the passage of gas or movement of the bowels does not eliminate the possibility of obstruction. The bowel distal to the obstruction is unimpaired and may function normally, completely emptying itself of gas and feces. Wangensteen and Goehl state that good results may be obtained by an enema, and unless this is kept in mind, a false security may result from a copious passage of gas or evacuation of the bowels.

Tenderness or muscle rigidity is present with loop obstruction only when the distended loop of congested bowel is in contact with the parietal peritoneum. Vomiting is dependent upon the duration and the level of the obstruction and the degree of the distention. The very absence of early physical signs suggests the possibility of

bowel obstruction and, in a patient who has had one or more abdominal operations, should bring to the surgeon's mind the possibility of adhesive obstruction and cause him to seek the information which the radiologist can so accurately furnish.

In partial obstruction much difficulty may be experienced in making a diagnosis from the radiographic film unless intermittent complete obstruction is present. Lockwood emphasizes the advantage of an opaque medium as an aid to diagnosis. Its significance centers around the rapidity of its progress through the intestinal tract. Any retardation of the barium or the detection of a malformed loop is of great significance. Frequent films are necessary to follow the barium in its intestinal advance.

The indications for the use of the Miller-Abbott tube in small-intestinal obstruction are very definite. In our hospital the procedure of passing the tube is usually quickly accomplished by our radiologist, Dr. Ira H. Lockwood, and his associates, whose splendid co-operation we acknowledge. This we believe to be a function of the radiological department, as intestinal intubation can be done successfully only under fluoroscopic observation. The tube is indicated and extremely useful in simple adhesive obstruction with extensive proximal distention and for decompression prior to operation. It is valuable in early obstruction of a similar nature to prevent postoperative ileus and to hasten restoration to normal of an already partially distended bowel. It is not indicated as a preoperative measure in loop obstruction, in volvulus, or strangulated obstruction where the viability of the bowel is in jeopardy. It may be valuable as a postoperative decompressing agent to prevent further distention and to hasten restoration of bowel tone. Although the Miller-Abbott tube has fallen into disrepute in many sections of the country, we feel that it is beneficial and can be applied in selected cases of intestinal obstruction.

The passage of the Miller-Abbott tube into the small bowel requires patience, along with a certain amount of skill. We are under the impression that much time can be saved the patient by starting the intubation under fluoroscopic control. The procedure followed by Lockwood is as follows:

Fig. 7. Case VII: Gas-filled intestine indicating an intussusception that required surgical reduction.

The patient is brought to the x-ray department with the necessary equipment. The tube is assembled and checked by the radiologist. If the patient is apprehensive, gags easily, or is restless, he is given sodium phenobarbital (grains 1 to 4 intravenously, depending upon his size) along with atropine (grains 1/150 to 1/75). We feel that the depressant action of the phenobarbital on the gastro-intestinal tract is much less than that usually accompanying an opiate.

The tube is inserted into the stomach through the nose and pushed down along the greater curvature in an attempt to pass it through the pylorus. If the tube does not enter the duodenum immediately, the balloon of the tube is inflated slightly and

is left in close proximity to the duodenum. Peristaltic action of the stomach will pull the tube through into the small bowel in the average case.

In patients with paralytic ileus and in moribund patients the instillation of hypertonic saline into the colon or an infusion of hypertonic saline into the vein will result in an increase in the peristaltic activity of the bowel. Only one word of caution—the reaction to the saline is sometimes violent. One must be sure that the tube is on its way down into the small bowel before the saline is administered, as perforation of the bowel may result without any means of decompression.

In our series of cases with the Miller-Abbott tube used as an adjunct in intestinal obstruction we found a definite improvement in the condition of the patients in twelve to twenty-four hours.

CONCLUSIONS

1. The x-ray should be more frequently employed by the surgeon as a diagnostic agent in suspected small-bowel obstruction.

2. A radiographic film reveals much information concerning the patency of the small-intestinal tract.

3. The probable location and nature of the obstruction can be determined by radiographic study.

4. The immediate urgency of surgery can be determined by the type of bowel distention, there being usually a different pattern of gas distribution in the simple than in the strangulated obstruction.

5. Many features serving to distinguish between mechanical obstruction and ileus can be observed by radiographic study.

6. The value of a barium enema in the reduction of intussusception is emphasized.

7. Clinical analysis of the symptom complex should be a part of the radiologist's information in interpreting the x-ray film.

8. The indications for use of the Miller-Abbott tube are stressed and a method of passage is described. Passage of the tube is a function of the radiological department.

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The Roentgenologic Features of Mediastinal Tumors[1]

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ALTHOUGH MEDIASTINAL tumors are not common, their incidence is frequent enough to warrant further investigation. Up to the present time their preoperative classification has proved difficult or impossible, but in view of the continued progress in the field of thoracic surgery, their differentiation prior to operation has become increasingly important. The present study was undertaken in an effort to determine whether any of these tumors had characteristic roentgenologic features.

During the period from 1938 through 1942, 44 cases of proved mediastinal tumor were found among approximately 60,000 chests examined at the Massachusetts General Hospital. Malignant lymphoma and metastatic involvement of the mediastinal lymph nodes were not included in this study. Heuer and Andrus (3), in a monograph covering the literature up to 1940 and including their own cases, reviewed a great variety of mediastinal tumors and discussed their diagnosis and treatment. Our group is smaller and does not include as many different types of tumor, but all of the 44 cases were proved by operation, aspiration, or autopsy. The series included 25 congenital tumors—15 "bronchiogenic" cysts (6), 7 dermoid cysts, and 3 malignant teratomata—14 tumors of neurogenic origin, 1 malignant tumor, unclassified, and 4 tumors of the thyroid, parathyroid, or thymus glands. The last 4 included 2 intrathoracic goiters, one thymic tumor, and one tumor of the parathyroids.

CONGENITAL TUMORS

Bronchiogenic Cysts (6): From the roentgenologic point of view the most important diagnostic feature of a bronchiogenic cyst is a smooth, round or ovoid shadow arising anywhere within the mediastinum without evidence of bone erosion or calcification. Demonstration of tracheal attachment offers additional diagnostic evidence, but is not conclusive, since a substernal thyroid, an aneurysm of the innominate artery, and other masses may be attached to the trachea and may present a similar appearance. It should be remembered also that bronchiogenic cysts may grow within the lung as well as in the mediastinum.

Unless the cyst becomes infected, its discovery is usually incidental. Those cysts in our series which became infected simulated lung abscess, or empyema with a bronchial fistula, in symptomatology and somewhat in their roentgen appearance. In the group of 15 the sex distribution was about equal, 8 males and 7 females.

Dermoid Cysts (*Fig. 1*): All of the 7 dermoid cysts were in the anterior mediastinum. Only one was found in the upper portion; the others were located in the middle and inferior portions. As a rule, the outline of the dermoid cyst was slightly irregular as compared to the smooth, rounded outline of the bronchiogenic cyst. In size the dermoid cysts varied from 7 cm. to 17 cm. in diameter. Three showed calcification in the wall, one with actual bone formation. In one case, the cyst communicated with a bronchus and showed a fluid level, as well as what was apparently semisolid material. None showed fluid in the pleural cavity. In 2 cases, atelectasis of the adjacent lung was present.

Teratomata (*Fig. 2*): The 3 teratomata in the group were located in the anterior mediastinum. Two showed slight lobulation of outline; the third was smooth. All were homogeneous in density; all showed a small amount of atelectasis of the adjacent lung, and all gave evidence of fluid

[1] From the Department of Radiology, Massachusetts General Hospital, Boston, Mass. Accepted for publication in December 1943.

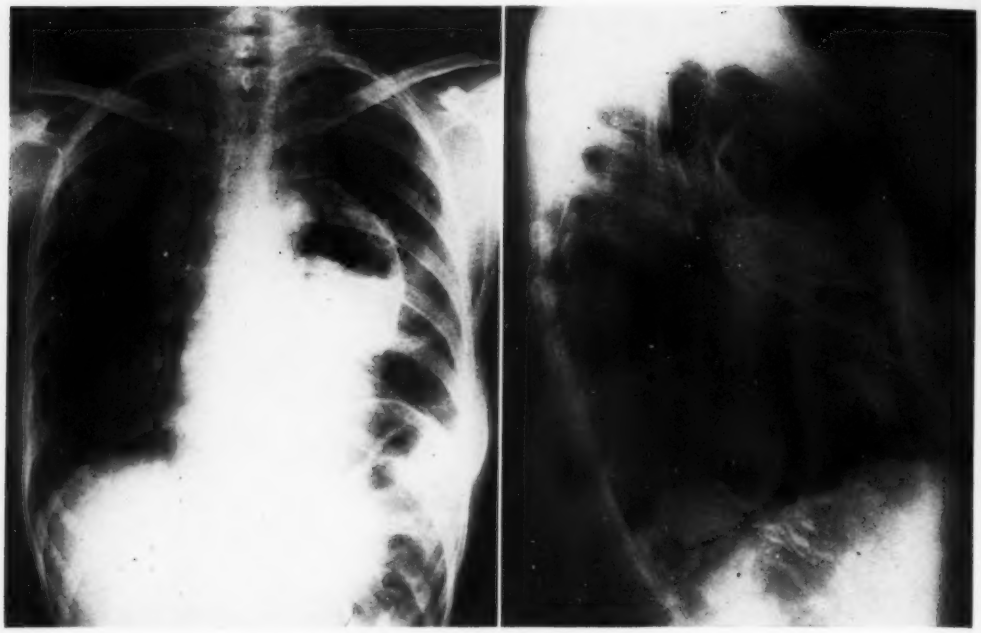

Fig. 1. A 46-year-old female entered the hospital because of hemoptysis of eleven weeks' duration. The right breast had been removed for carcinoma one year before. A partially cystic mass with calcification in the wall and containing air, fluid, and semisolid material arose from the left mediastinum. The dense area of calcification overlying the aortic arch was thought to represent an incompletely developed tooth fragment. Bronchoscopy was negative. Thoracotomy was done and a dermoid cyst was excised. There was a fistulous connection with a branch of the left upper lobe bronchus.

in the pleural cavity. All 3 patients died: one at operation; one the day following aspiration biopsy (death was not related to the operation so far as could be determined); and the third several months after x-ray therapy, with metastases in the liver and lumbar spine.

TUMORS OF NEUROGENIC ORIGIN

The group of neurogenic tumors was composed of 10 neurofibromata, 2 ganglioneuromata, and 2 cases diagnosed as neuroblastoma, which probably belong to the group commonly called sympathetic neuroblastoma. In 9 cases the tumor arose in the posterior mediastinum. This is readily understood, since the majority of nerves, including the sympathetic ganglia, are located in this area. Five tumors, however, arose in the anterior mediastinum. A recent report concerned neurofibromata arising from the vagus nerve (2). In some of our cases it has been difficult to determine the exact nerve from which the tumor originated. Although dumb-bell neurofibromata are relatively common, none of the present group was of that type.

There are no differential diagnostic points to characterize fibromata, ganglioneuromata, or the malignant variations of these types of tumor. Of the 14 neurogenic tumors, all were homogeneous in density (Fig. 3). One was attached to the lower third of the esophagus in the middle portion of the mediastinum. The majority of the tumors were smooth: 4 showed slight lobulation. The size varied from 6 cm. in diameter up to a mass entirely filling one side of the chest. In 3 cases there was collapse of a lung, or a portion of the lung, due to pressure on a bronchus. In no instance was there fluid in the pleural cavity. Calcification was present in 3 cases.

It has been said that erosion of bone is

Fig. 2. A 33-year-old male entered the hospital because of a superior mediastinal syndrome with extreme dyspnea. The possibility of malignant lymphoma was considered and a therapeutic trial of radiation was given. The mass continued to grow, however, and the patient re-entered the hospital in a critical condition three weeks later. An aspiration biopsy was done. Death occurred the following day, but not as a result of the operation. At autopsy, malignant teratoma was found in the right superior mediastinum, with metastases in the mediastinal lymph nodes and lung. Partial obstruction of the superior vena cava and atelectasis of the right upper lobe were present.

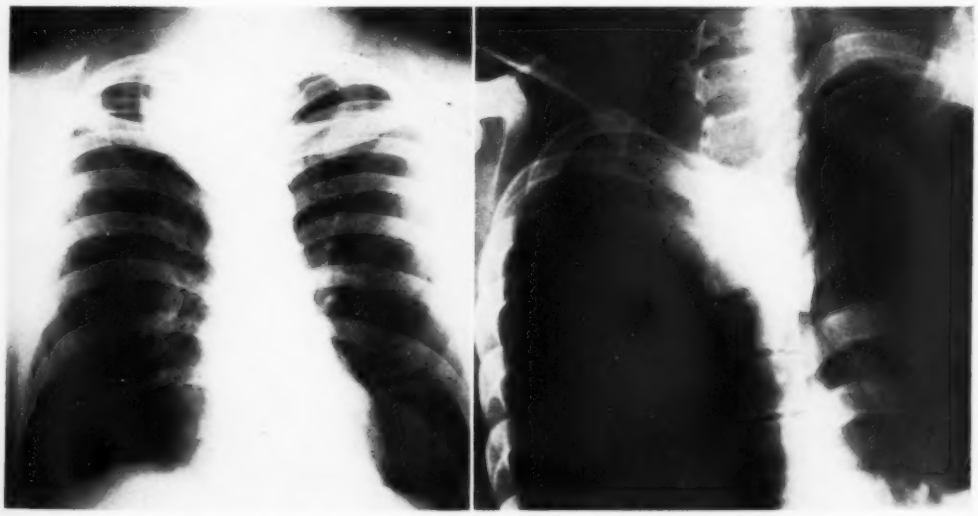

Fig. 3. A 24-year-old, single male entered the hospital with a three-year history of increasing nervousness, dyspnea, and palpitation on exertion. There had been no hemoptysis and no cough. There was a Horner's syndrome on the right. Roentgenologic examination of the chest revealed a smooth, sharply defined, rounded mass projecting into the right apex from the superior mediastinum. It lay in the posterior portion of the mediastinum. There was no evidence of bone erosion. The pleural reflection was well demonstrated in the oblique view. The tumor was incompletely removed. Histopathologic diagnosis: Ganglioneuroma.

Fig. 4. A 41-year-old female entered the hospital for study of dyspnea. The onset followed an acute upper respiratory infection a year and a half before. Roentgen examination of the chest revealed a smooth, round, soft-tissue mass posteriorly, overlying the 8th to the 10th ribs. There was definite erosion of the 9th rib close to the region of the angle. A diagnosis of neurofibroma was made. The tumor was removed surgically. Histopathologic diagnosis: Neurofibroma.

Fig. 5. A 63-year-old male entered the hospital for diagnosis and treatment of a mass in the right superior mediastinum. This mass was discovered accidentally during investigation of pain in the region of the right shoulder. The patient received a therapeutic trial of x-ray irradiation elsewhere without effect. The mass lay in the mid-portion of the mediastinum displacing the trachea anteriorly and the esophagus to the left. It was attached to the trachea and was thought to represent a cyst. Operation showed it to be an intrathoracic colloid goiter. (This case was published as Case 29402, Case Records of the Massachusetts General Hospital, New England J. Med. **229:** 595, 1943.)

indicative of malignancy. Six patients of this group showed bone changes which we have described as erosion. In this sense, however, the word "erosion" denotes an apparent wearing away of bone as from constant pressure (Fig. 4). These changes are similar to those seen in the spine due to aortic aneurysm. The term "erosion" has been applied in sharp contrast to "bone destruction," such as is seen in malignant bone lesions. In no instance in this group was there evidence of invasion of the bone by tumor.

Two of the neurogenic tumors were malignant, being diagnosed as neuroblastoma. From the roentgenologic examination there was nothing to indicate malignancy; neither case showed evidence of pleural fluid, bone destruction, or invasion of the lung. There was nothing in the history or in the roentgen examinations to indicate rapid growth of the lesion in either instance. Since the benign and the malignant tumors of this type cannot be differentiated, it becomes more apparent that surgery is the treatment of choice.

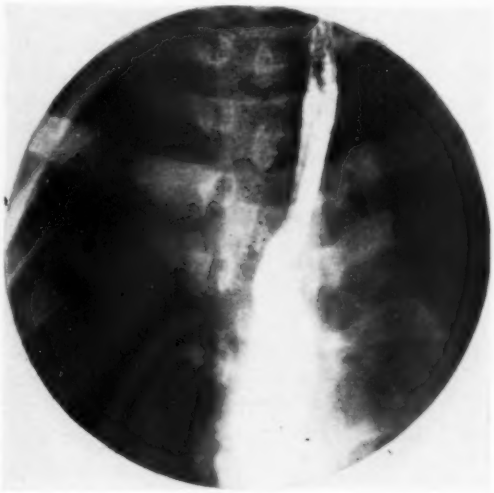

Fig. 6. A 22-year-old female entered the hospital for study. The bones showed the classical changes of hyperthyroidism. There had been previous explorations of the parathyroid areas. Roentgenologic examination of the chest revealed a 5 × 2.5 cm. mass in the right upper mediastinum, displacing the trachea and esophagus to the left. This mass was interpreted as a substernal parathyroid tumor. Operation and histopathologic examination confirmed this diagnosis. (This case was published as Case 25261, Case Records of the Massachusetts General Hospital, New England J. Med. **220**: 1082, 1939.)

MALIGNANT TUMOR, UNCLASSIFIED

One of the group was a tumor presenting in the right mid-chest, which, prior to operation, was thought to be a benign lesion. It proved to be malignant but could not be classified. The patient had shown symptoms consistent with a superior mediastinal syndrome. Roentgenologically the tumor showed slight lobulation; there was some atelectasis within the lung, and a small amount of fluid within the pleural cavity.

TUMORS OF THYROID, PARATHYROID, AND THYMIC ORIGIN

Goiter: The easily recognized substernal goiter was not included in this series. It usually lies in the anterior superior mediastinum, has either a smooth or lobulated outline, and often shows an area of calcification. It is attached to the trachea, displacing it to one side or the other, with the greatest displacement at the largest portion of the tumor. The displacement extends upward to the larynx (1).

Intrathoracic goiter (Fig. 5), in contrast to substernal goiter, may be mistaken for a mediastinal tumor roentgenologically. The two cases of intrathoracic goiter in our series were both diagnosed preoperatively as mediastinal cysts. One was located in the right antero-inferior mediastinum and was resting on the diaphragm; the second was in the right superior mediastinum, posterior to the trachea and displacing the esophagus. The tumors were smooth in outline and homogeneous in density. In each case, a small amount of atelectasis of lung was present; in neither was there evidence of bone change or fluid in the pleural cavity. At operation, the goiter in each case was found attached to the trachea, although in the one which rested on the diaphragm this attachment was not demonstrated roentgenologically.

Tumors of Parathyroids and Thymus: In only one case was a parathyroid tumor

visible roentgenologically, and this was found in the right superior mediastinum, displacing the trachea and esophagus to the left. Except for its appearance as a smooth mass, no special roentgen characteristics were noted. The diagnosis was aided considerably by the fact that the patient gave evidence of hyperparathyroidism both clinically and roentgenologically (Fig. 6).

One patient with myasthenia gravis had an unrecognized mass in the anterior mediastinum[2] which was in the region of the thymus, casting a shadow overlying the pulmonary artery, for which it was mistaken. On exploration this proved to be a benign thymoma.

DISCUSSION

It will be seen from the foregoing descriptions that no infallible roentgenologic characteristics, specific for each type of mediastinal tumor, have been demonstrated, although certain findings are suggestive. Nor are the clinical findings of diagnostic value in differentiating types of tumor. In many instances, the discovery of a mediastinal tumor is purely accidental and, because of this fact, it is probable that an apparent increase in the incidence of all types of mediastinal tumors will follow the increase in routine chest examinations which World War II has brought about.

In order to demonstrate successfully a mediastinal tumor, the roentgenologic technic requires first roentgenoscopy, which will show the dynamics of the tumor and its attachments and will determine the films to be taken. The minimum necessary roentgenograms include the routine postero-anterior view, a lateral view, and an over-exposed anteroposterior view with the Potter-Bucky diaphragm. Occasionally oblique views are of definite diagnostic value. Tracheal attachment of the tumor is readily demonstrable by having the patient swallow, and noting if the mass moves with the trachea. Any mass attached to the trachea can give this sign. The more common lesions which produce it are intrathoracic thyroid, bronchiogenic cyst, and aneurysm of the innominate artery, and it should be remembered that any one of these lesions may show transmitted pulsation. Pressure of the tumor against the esophagus may be discovered by the demonstration of an extrinsic pressure defect. In some cases intramural, extramucosal involvement of the esophagus by the tumor (7) may be revealed with the aid of roentgenoscopy and "spot" films. Tumors located in the wall of the esophagus are likely to be of the spindle-cell type or bronchiogenic cysts.

The postero-anterior and lateral roentgenograms as a rule indicate the location of the mass in the chest. It is at times difficult, however, to determine whether the tumor lies within the mediastinum or in the parenchyma of the lung. If the pleural reflection at the edge of the tumor can be demonstrated (and for this an over-exposed view in addition to the ordinary technic may be required) the tumor can be located with greater accuracy. Although we have not had very successful results after injection of air into the pleural cavity, it seems as if accurate localization of the tumor should be possible by this method. Once the location of the mass is definite, its configuration and its effect on adjacent structures (such as pressure on the bronchi, rib erosion, or attachment to the esophagus or trachea) are of further diagnostic value. Moore (4) found laminagrams valuable in separating the mass from other structures within the mediastinum. Reynolds and Leucutia (5) suggest as a final diagnostic procedure a trial dose of radiation.

CONCLUSIONS

With the present methods of roentgenologic examination no exact differentiation of mediastinal tumors is possible. Certain diagnostic features in various types of tumor have been demonstrated, however. The most important of these are as follows:

[2] Detailed studies of thymic tumors and myasthenia gravis from surgical, medical, and roentgenologic standpoints are in preparation by Oliver Cope, M.D., of this hospital, and it is through his courtesy that this case is included.

Congenital Tumors

Bronchiogenic Cysts: A round or ovoid tumor located anywhere within the mediastinum without evidence of calcification or bone erosion.

Dermoid Cysts and Teratomata: A mass, slightly more irregular in outline, located in the anterior mediastinum, which may contain foci of calcification.

Neurogenic Tumors: Any one of these tumors is usually smooth in outline, homogeneous in density, and may be located in any portion of the mediastinum. Bone erosion (contradistinguished from bone destruction) is commonly associated with this type of tumor.

Tumors of Thyroid, Parathyroid, and Thymic Origin: The outstanding finding in intrathoracic goiter is its attachment to the trachea. Parathyroid and thymic tumors may be recognized as mediastinal tumors but their significance is largely dependent upon other roentgenologic or clinical characteristics.

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A Statistical Analysis of 100,000 Examinations of the Chest by the Photoroentgen Method[1]

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IN THE ACCOMPANYING tables are presented the results of routine examinations of the chest by the photoroentgen method in 100,000 consecutive selectees forwarded for possible induction to an Armed Forces Induction Station. All of the chest films were interpreted by one or the other of the authors; many of them were seen by both authors before acceptance or rejection was advised.

THE METHOD

The routine roentgenologic examination of the chest by means of stereoscopic 14 × 17-in. films has until recently been the method of choice for the detection of tuberculosis of the lungs. The introduction and perfection of the photoroentgen method, using 4 × 10-in. film, on which are obtained stereoscopic exposures of the chest, has made obsolete the older method. The economy resulting from the use of the smaller film (the basic cost of these films being about one-twentieth that incurred when using stereoscopic 14 × 17-in. films) is the major factor involved in mass surveys, either in or out of the Army. But the concentrated field of vision, the sharpness and definition of the image on the smaller film, and the rapidity with which interpretation can be made are added factors favoring this method of examination. The use of a Lysholm grid in front of the intensifying screen is a factor in the production of superior film quality.

APPARATUS

In the case of the examinations here reported, the energizing unit happened to be of General Electric X-Ray Corporation design and manufacture, with the General Electric Photoroentgen Unit. The Lysholm grid was used in all examinations. The technic varied slightly from time to time, but in the main consisted in the use of approximately 85 kv., 175–200 ma., a target-screen distance of 40 in., and an average exposure time of 0.25 second. Tube life has been satisfactory, considering the speed with which examinations have to be made. The maintenance of a schedule of one examination each 45 seconds will result in increased tube life. Any deviation from this schedule tending toward a more rapid rate of examination will inevitably tend to greater tube cost.

SCOPE OF THIS REPORT

All selectees, and others reporting to this station for physical examination, were routinely examined by this method. Films are reviewed and a report is made prior to a decision as to acceptability or rejection for service. Special emphasis is naturally placed on the detection and elimination of pulmonary tuberculosis, though an attempt has been made to record accurately all abnormal findings on chest examination. The present report deals only with the results of chest examination in 100,000 consecutive selectees reporting to this station during the latter part of 1942 and the early part of 1943. Of the selectees

TABLE I: CHEST LESIONS DISCOVERED BY PHOTOROENTGENOGRAPHY IN 100,000 SELECTEES

	White	Colored	Total
Disqualifying lesions	489	862	1,351 (1.35%)
Non-disqualifying lesions	578	684	1,262 (1.26%)
Total	1,067	1,546	2,613 (2.61%)

[1] From The Armed Forces Induction Station, Fort Bragg, N. C. Accepted for publication in December 1943.

TABLE II: LESIONS OF THE THORACIC CAGE

	Rejections for Thoracic Cage Lesions			Non-Disqualifying X-Ray Findings			Total with Thoracic Cage Lesions			Rejection Rate per Thousand		
	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total
I. Deformities of thorax												
(a) Asymmetry												
1. Congenital	..	2	2	4	2	6	4	4	8	..	0.02	0.02
2. Traumatic	..	..	...	...	...	...	...	...	...	..	..	..
II. Clavicles												
(a) Absence	..	1	1	...	...	...	...	1	1	..	0.01	0.01
(b) Fractured	1	2	3	3	3	6	4	5	9	0.01	0.02	0.03
III. Ribs												
(a) Cervical	..	..	...	130	123	253	130	123	253	..	..	..
(b) Deformed and defective												
1. Congenital												
Fusion and forking	..	..	...	11	18	29	11	18	29	..	..	..
Synchondrosis 1st ribs	..	..	...	...	7	7	...	7	7	..	..	..
Rudimentary 1st ribs	..	..	...	4	12	16	4	12	16	..	..	..
Deformed ribs	..	..	...	3	3	6	3	3	6	..	..	..
2. Traumatic and diseased												
Result of thoracotomy	..	6	6	7	17	24	7	23	30	..	0.06	0.06
Fractured	1	..	1	10	13	23	11	13	24	0.01	..	0.01
Tumors	2	1	3	...	...	...	2	1	3	0.02	0.01	0.03
Early calcification of costal cartilages	..	..	...	14	9	23	14	9	23	..	..	..
IV. Vertebral column												
(a) Kyphoscoliosis	27	8	35	3	1	4	30	9	39	0.27	0.08	0.35
(b) Scoliosis	39	10	49	50	43	93	89	53	142	0.39	0.10	0.49
(c) Fractures	2	1	3	...	...	...	2	1	3	0.02	0.01	0.03
V. Diaphragm												
(a) Congenital weakening	6	..	6	3	1	4	9	1	10	0.06	..	0.06
(b) Eventration	3	4	7	...	...	...	3	4	7	0.03	0.04	0.07
(c) Hernia	..	1	1	...	...	...	...	1	1	..	0.01	0.01
VI. Foreign bodies												
(a) Soft tissues—thoracic wall	1	..	1	70	22	92	71	22	93	0.01	...	0.01
TOTAL	82	36	118	312	274	586	394	310	704	0.82	0.36	1.18

examined, 45,557 were white, and 54,443 were colored or non-white.

GENERAL SUMMARY AND EXPLANATION OF STATISTICAL TABLES

Of the 100,000 men examined, a total of 1,351, or 1.35 per cent, were rejected for military service because of the presence of chest disease alone: 489 white (1.07 per cent) and 862 non-white (1.58 per cent). In addition, 578 white and 684 colored selectees presented non-disqualifying chest findings regarded as worthy of note, comprising 1.26 per cent of all men examined. Abnormal findings, disqualifying and non-disqualifying, were recorded in 2.61 per cent of all those examined (Table I).

The disqualifying and non-disqualifying lesions and abnormalities of the thoracic cage are listed in Table II. In this group 36 white and 82 colored (118 total) were rejected (1.18 per thousand); 274 white and 312 colored (586 total) presented non-disqualifying chest wall findings. The incidence of conditions involving the thoracic cage was 7.04 per thousand.

The incidence of various tuberculous processes within the chest is shown in Table III. The classifications were arbitrary, not confirmed by prolonged clinical observation or study, and they are therefore subject to later modification not within the scope of this survey. Decision had to be made with induction or rejection (either permanent or temporary) as the end-result of that decision in each case. One hundred and twenty-nine white and 145 colored selectees were rejected for active pulmonary tuberculosis—a total (combined) rejection rate of 2.74 per thou-

TABLE III: PULMONARY TUBERCULOSIS

	Rejections			Non-Disqualifying X-Ray Findings			Total with Tuberculosis			Under Minimum Height and Weight Standards			Rejection Rate per Thousand		
	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total
I. Active															
(a) Primary															
1. Tracheobronchial	1	...	1	..	..	..	1	...	1	..	..	...	0.01	..	0.01
2. Primary complex	...	2	2	..	..	..	...	2	2	..	1	1	..	0.02	0.02
3. Parenchymal	...	...	...	..	..	..	...	...	...	..	..	...	..	..	..
(b) Reinfection type															
1. Minimal	9	12	21	..	..	..	9	12	21	..	4	4	0.09	0.12	0.21
2. Moderately advanced	88	83	171	..	..	..	88	83	171	14	22	36	0.88	0.83	1.71
With cavitation	15	10	25	..	..	..	15	10	25	5	3	8	0.15	0.10	0.25
3. Far-advanced	11	5	16	..	..	..	11	5	16	3	3	6	0.11	0.05	0.16
With cavitation	14	12	26	..	..	..	14	12	26	9	8	17	0.14	0.12	0.26
(c) Acute															
1. Miliary	2	...	2	..	..	..	2	..	2	1	..	1	0.02	..	0.02
2. Hematogenous	1	1	2	..	..	..	1	1	2	..	..	...	0.01	0.01	0.02
(d) Moderately advanced with therapeutic pneumothorax	3	3	6	..	..	..	3	3	6	..	..	...	0.03	0.03	0.06
(e) Pleuritis, tuberculous	1	1	2	..	..	..	1	1	2	1	1	2	0.01	0.01	0.02
TOTAL	145	129	274	..	..	..	145	129	274	33	42	75	1.45	1.29	2.74
II. Arrested															
(a) Primary															
1. Primary calcified nodes	4	6	10	32	43	75	36	49	85	2	3	5	0.04	0.06	0.10
(b) Reinfection type															
1. Minimal parenchymal	34	36	70	13	3	16	47	39	86	3	10	13	0.34	0.36	0.70
2. Moderately advanced	61	66	127	..	..	..	61	66	127	8	12	20	0.61	0.66	1.27
TOTAL	99	108	207	45	46	91	144	154	298	13	25	38	0.99	1.08	2.07
III. Questionable activity	3	7	10	..	..	..	3	7	10	..	2	2	0.03	0.07	0.10
GRAND TOTAL	247	244	491	45	46	91	292	290	582	49	69	115	2.47	2.44	4.91

TABLE IV: PULMONARY TUBERCULOSIS: SUMMARY

	Active			Arrested			Questionable Activity			Total		
	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total
Rejected for tuberculosis	145	129	274	99	108	207	3	7	10	247	244	491
Non-disqualifying x-ray findings	..	..	..	45	46	91	...	...	...	45	46	91
Total with tuberculous lesions	145	129	274	144	154	298	3	7	10	292	290	582
Under minimum height and weight standards	33	42	75	13	25	38	...	2	2	49	69	115
Rejection rate per 1,000	1.45	1.29	2.74	0.99	1.08	2.07	0.3	0.7	0.10	2.47	2.44	4.91

sand examined. Of these men, 42 white and 33 colored were below the standards of weight for acceptance. In the group presenting arrested tuberculous lesions (opinion of examiner) were 108 white and 99 colored selectees (207 rejections), giving a rejection rate of 2.07 per thousand. Only 46 white and 45 colored selectees presented arrested tuberculous processes which were considered non-disqualifying and acceptable for induction.

All cases of pulmonary tuberculosis reported in this series are shown in Table IV. Of the 491 selectees rejected, 244 were white and 247 were colored or nonwhite; 91 men were accepted with what

TABLE V: NON-TUBERCULOUS LUNG AND PLEURAL LESIONS

	Rejections			Non-Disqualifying X-Ray Findings			Total			Under Minimum Height and Weight Standards			Rejection Rate per Thousand		
	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total
I. Congenital															
(a) Azygos lobe	...	...	...	55	50	105	55	50	105	..	..	..	..	..	..
(b) Cystic lung disease	2	1	3	...	...	...	2	1	3	..	1	1	0.02	0.01	0.03
II. Traumatic															
(a) Pneumothorax, traumatic and spontaneous	2	3	5	...	...	...	2	3	5	1	..	1	0.02	0.03	0.05
(b) Foreign body, lungs	4	...	4	...	...	...	4	...	4	..	..	..	0.04	..	0.04
III. Infections and non-infections															
(a) Pulmonary infiltration: type undetermined	27	32	59	...	...	...	27	32	59	1	4	5	0.27	0.32	0.59
(b) Lung abscess	7	3	10	...	...	...	7	3	10	2	1	3	0.07	0.03	0.10
(c) Tracheobronchial lymphadenopathy	43	14	57	...	...	...	43	14	57	2	3	5	0.43	0.14	0.57
(d) Heavy root shadows	9	4	13	123	104	227	132	108	240	1	4	5	0.09	0.04	0.13
(e) Fibrosis: type undetermined	4	2	6	32	27	59	36	29	65	..	4	4	0.04	0.02	0.06
(f) Empyema															
1. Sacculated	1	1	2	...	...	...	1	1	2	1	..	1	0.01	0.01	0.02
2. Non-sacculated	1	1	2	...	...	...	1	1	2	..	..	..	0.01	0.01	0.02
(g) Pleuritis															
1. Adhesive	30	19	49	73	42	115	103	61	164	5	3	8	0.30	0.19	0.49
2. With effusion															
Sacculated	19	7	26	1	...	1	20	7	27	3	..	3	0.19	0.07	0.26
Non-sacculated	5	2	7	1	...	1	6	2	8	..	..	..	0.05	0.02	0.07
Calcified	4	1	5	1	1	2	5	2	7	..	..	..	0.04	0.01	0.05
(h) Pneumoconiosis	8	7	15	...	...	...	8	7	15	1	2	3	0.08	0.07	0.15
1. Mycosis	1	...	1	...	...	...	1	...	1	..	..	..	0.01	..	0.01
(i) Bronchiectasis	42	32	74	...	...	...	42	32	74	3	11	14	0.42	0.32	0.74
(j) Tumors															
1. Lungs	6	2	8	...	...	...	6	2	8	..	..	..	0.06	0.02	0.08
2. Mediastinum	2	...	2	...	...	...	2	...	2	..	..	..	0.02	..	0.02
3. Pleurae	...	1	1	...	...	...	...	1	1	..	..	..	..	0.01	0.01
(k) Emphysema	4	2	6	...	...	...	4	2	6	2	1	3	0.04	0.02	0.06
TOTAL	221	134	355	286	224	510	507	358	865	22	34	56	2.21	1.34	3.55

were considered arrested or healed tuberculous lesions. Of the total 582 men, approximately 20 per cent were below the acceptable weight standards for their height.

All non-tuberculous conditions of the lungs and pleurae were recorded and are shown in Table V. Three hundred and fifty-eight white and 507 colored or non-white presented some abnormality which was considered to be non-tuberculous. In 224 white and 286 colored or non-white (510 total) the condition was non-disqualifying in the opinion of the examiner. One hundred and thirty-four white and 221 colored or non-white selectees were rejected for non-tuberculous pulmonary or pleural lesions (355 total), a rejection rate of 3.55 per thousand examined. Of these men, only 56 were under the acceptable standards for weight.

Abnormalities of the heart, pericardium, and great vessels were also recorded. A total of 462 men (109 white and 353 colored or non-white) presented what were considered significant findings. Only 75 of this group were considered qualified for induction; 387 were rejected (75 white and 312 colored or non-white), giving a rejection rate of 3.87 per thousand. Twelve white

TABLE VI: DISEASE OF THE HEART, PERICARDIUM, AND GREAT VESSELS

	Rejections			Non-Disqualifying X-Ray Findings			Total			Under Minimum Height and Weight Standards			Rejection Rate per Thousand		
	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total	Col.	Wh.	Total
I. Congenital heart disease	2	1	3	..	..	..	2	1	3	..	1	1	0.02	0.01	0.03
II. Dextrocardia	...	..	...	4	8	12	4	8	12	..	1	1	..	..	..
III. Microcardia	6	7	13	..	..	..	6	7	13	2	2	4	0.06	0.07	0.13
IV. Organic heart disease															
(*a*) Enlarged heart	36	11	47	8	..	8	44	11	55	4	2	6	0.36	0.11	0.47
(*b*) Mitral disease	46	14	60	27	24	51	73	38	111	3	3	6	0.46	0.14	0.60
(*c*) Hypertensive heart	143	31	174	2	1	3	145	32	177	1	..	1	1.43	0.31	1.74
(*d*) Aortic valvular disease															
1. Early aortitis	62	8	70	..	1	1	62	9	71	2	2	4	0.62	0.08	0.70
2. Syphilitic aortitis	12	2	14	..	..	..	12	2	14	..	..	..	0.12	0.02	0.14
V. Pericardial diseases															
(*a*) Effusion	1	..	1	..	..	..	1	...	1	..	..	..	0.01	..	0.01
(*b*) Pericarditis	2	1	3	..	..	..	2	1	3	..	1	1	0.02	0.01	0.03
VI. Aneurysms															
(*a*) Ascending aorta	1	..	1	..	..	..	1	...	1	..	..	..	0.01	..	0.01
(*b*) Transverse aorta	1	..	1	..	..	..	1	...	1	1	..	1	0.01	..	0.01
TOTAL	312	75	387	41	34	75	353	109	462	13	12	25	3.12	0.75	3.87

and 13 colored selectees in this group were under minimum standards for acceptance so far as weight was concerned (Table VI).

DISCUSSION

The rapid and accurate physical examination of men required for the building up of an army, including roentgen examination of the chest of each selectee or volunteer, necessitated the introduction of a method which would be less expensive than the use of the conventional 14 × 17-in. film, and one which would permit of swift processing and rapid interpretation. Our experience with the photoroentgen method with 4 × 10-in. film has convinced us that the use of the smaller film is practicable. The stereoscopic demonstration of the lungs on the 4 × 10-in. single-coated film is superior in definition to that on any single 14 × 17-in. (flat) film of the chest. The smaller film, presenting a concentrated and smaller field of vision, can be rapidly and accurately surveyed; the roentgen images are sharply defined; the pathological processes well demonstrated. Eye fatigue is at a minimum with the use of this film and the orthostereoscope. We have not found it necessary to confirm findings with the 14 × 17-in. film, and have seen lesions, clearly defined on the smaller film, missed on the larger film.

The demonstration by Army Induction Stations of the practicability and accuracy of this method of chest examination, as well as the experience gained by such mass surveys in civil life, leads one logically to hope that through the use of this inexpensive method large groups can be surveyed and cases of early pulmonary tuberculosis recognized during the stage when they can be successfully treated.

BRIEF REVIEW OF CURRENT LITERATURE

Lees, reporting an x-ray study of 6,066 teachers, gives the incidence of tuberculosis as about 2.15 per cent (10). Levitin (11), on the basis of 10,000 chest examinations with 4 × 5-in. film, reports the incidence of reinfection tuberculosis as 1.36 per cent. He remarks: "It was astonishing to find the number of men with active tuberculosis having no suspicion of the disease." The Ministry of Health in London, having introduced chest examinations by miniature radiography, reports that "so far

only about three out of every thousand examined have been found tuberculous." They admit, however, that there has been an increase in the tuberculosis death rate since the war (12). Heaf and Rusby (13) report that the "deaths from respiratory tuberculosis increased about six percent the first year of the war and ten percent the second." Plunkett (14) predicts that "tuberculosis will assume the proportions of a plague in Europe as the war progresses" and states that for the first time in twenty years the tuberculosis death rate shows an increase. Long (15) reports that "a rise in tuberculosis mortality rates appears already evident." Examination with the aid of miniature 35-mm. film revealed a percentage of 7.40 positive tuberculous in a population of 62,000 in Rio Grande, Brazil, and of 4.70 among 14,803 in Pelosta, Brazil (16). At this time, also, the Commonwealth of Australia has adopted the routine x-ray examination of entrants for the Australian Imperial Forces, with microradiography (17).

In the United States many cases of tuberculosis have been discovered through the Selective Service program. Through the double-screening process of the Local Draft and Induction Boards, the tuberculous have been effectively segregated. Major George D. Williams (18), reporting on "The United States Army Induction Board Experience," reveals that in all Corps Areas, from November 1940 to December 1941, the rejection rate for diseases of the lungs was 11.06 per thousand. From May through September 1942, the rejection rate for pulmonary tuberculosis per thousand in the United States was 16.33 for whites and 14.62 for colored. For the Fourth Corps Area it was 8.23 per thousand for white men and 8.99 for colored men. This was the lowest rate for all Corps Areas and was explained by the author as probably being due to the fact that the greater part of the men were from rural districts (18).

SUMMARY AND CONCLUSIONS

1. A statistical survey of 100,000 consecutive examinations of the chest in selectees reporting to an Armed Forces Induction Station, made by the photoroentgen method, is reported.

2. Stereoscopic roentgenograms on 4 × 10-in. film have been found highly satisfactory, economical, easy to handle and process, capable of being rapidly interpreted with minimum eye strain and fatigue, and superior in definition to 14× 17-in. films.

3. The rejection rate for pulmonary tuberculosis in this series was 4.91 per thousand examined. This rejection rate applies to all types of pulmonary tuberculosis, from far advanced active cases with cavitation to the chronic minimal fibrous or apparently arrested cases in which stability of the lesions was not yet demonstrated.

4. The low rejection rate for tuberculosis at this station reflects creditably on the splendid anti-tuberculosis program in North Carolina over the last quarter of a century, also on the screening out of known tuberculous selectees at the local boards of origin. Corrections for instances in which one or more examinations have been made on the same selectee have not been calculated for this series, but this correction is relatively small and in a group of this size would not be significant in its effect on the figures obtained. The relatively low population shift in the state of North Carolina and the accessibility of this type of population, largely native-born, to mass surveys may have been a contributing factor in the low rate of rejection obtained as a result of this study.

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Further Experiences with Venography[1]

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OUR EXPERIENCE with venography now includes over 350 cases. Technical considerations and anatomical and physiological observations covering the first third of this series have been recorded in a previous paper (1). A brief review of the technic follows.

Twenty cubic centimeters of contrast medium (diodrast) are injected into any accessible vein below the ankle, through a 25- or 26-gauge needle. A venipuncture is made through the skin without incision. The dye is injected over a period of two minutes. Three 14 × 17-in. films are used, with two exposures to a film, using one half of the film for each. The paired exposures are made from stereo positions. Two exposures cover the area from the ankle to the knee; two the area of the upper leg, knee, and lower thigh; and two the remainder of the thigh and the lower pelvis. The first exposure is made just after the injection of approximately 7 c.c., or after forty seconds have elapsed from the beginning of the injection. The other five exposures follow in rapid succession, the last being completed at approximately the time of completion of the injection, or two minutes after the beginning of the procedure. These exposures give three overlapping pairs of films including the area from the ankle to the lower pelvis.

In the normal subject the dye, passing upward, through the veins of the leg, clearly demonstrates the venous system. In the case of disease and slowing of the venous stream, the time element involved is such that in most cases visualization of the venous tree is obtained.

On the basis of a large number of cases in which a block of the venous stream was demonstrable at some point, it appears that for purposes of interpretation, the venous structures of the leg and thigh can be divided very simply into a superficial plexus and the deep veins. These two systems of venous return have many communications both in the leg and in the thigh. The internal saphenous, which is the normal collecting agency of the superficial plexus, and the femoral vein, which is the normal collection agency for the deep veins of the leg and knee, unite at the femoral fossa, forming the external iliac vein.

The number of cases now observed seems to be sufficient to warrant an attempt at classification of the abnormal or pathological venograms into definite types or patterns. We have taken 100 consecutive cases observed within recent months and arranged these according to the patterns presented. Table I shows how these cases fall into classes.

TABLE I: CLASSIFICATION OF VENOGRAPHIC PATTERNS IN 100 CONSECUTIVE CASES

SUPERFICIAL BLOCK (ONLY)		44
Acute		
Leg	7	
Leg and thigh	11	
Chronic		
Leg	6	
Leg and thigh	19	
Acute and chronic		
Leg	1	
DEEP BLOCK		50
Acute		
Leg	4	
Leg and thigh	7	
Chronic		
Leg	9	
Thigh	2	
Leg and thigh	28	
NORMAL		4
INCONCLUSIVE		2

This classification seems necessary for several reasons. First, from the clinical standpoint, a venogram is made primarily to give the surgeon a clue as to proper treatment of the affected leg. Treatment of a block of the superficial plexus usually does not involve as radical measures as

[1] Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–2, 1943.

Fig. 1. Acute superficial block, showing non-tortuous vessels of even caliber.

Fig. 2. Chronic superficial block: tortuous vessels of uneven caliber. Normal deep vessels visualized.

when the deep circulation is involved. Again, a classification according to definite patterns may help the radiologist who sees only a few such procedures better to understand and interpret the occasional venogram.

Throughout this paper, we prefer to use the word block rather than the term phlebitis, phlebothrombosis (2), or bland thrombosis (3). From the standpoint of the radiologist, the dye pattern in most cases actually demonstrates a block. The roentgenogram reveals no evidence of the etiology but indicates definitely the site and frequently the extent of the block. The table divides these patterns, then, into superficial and deep block, with subdivisions into acute and chronic.

Of these 100 cases, 44 showed evidence of superficial block, with the deep circulation intact. We feel definitely that this particular group would not be observed, or would at least be diagnosed only infrequently, by methods of single observation. Multiple observations are necessary to avoid mistakes in recognizing many of these patterns. In the acute superficial block, a portion of the dye goes into the deep circulation in the region of the ankle or just above. The deep circulation of the leg is visualized from this point upward to the femoral fossa. In the superficial circulation, the veins are comparatively straight and not tortuous (Fig. 1). The caliber of the separate veins is even. The dye spreads through the superficial plexus to the point of block. In the region of the block, two things may be observed.

The first and most easily demonstrated pattern shows the dye stopping abruptly at the site of a connecting vessel and turning directly inward or somewhat backward toward the deep circulation or another area

of the superficial plexus. From the point of block upward, no superficial plexus is demonstrated in the area of the block. The second pattern—slightly more difficult to recognize—in acute superficial block shows short lengths of straight, non-tortuous, and non-dilated veins extending upward and apparently fading out in the tissues. The difficulty in recognition of this pattern lies in the fact that the dye in the particular vein may be going upward slowly and a single observation may be incorrect. Two or preferably four films showing the dye fading out at the same point on all exposures give a definite clue to a block above the area where the dye is last visualized. Acute superficial block is frequently seen in the presence of chronic disease of the deep or superficial circulation.

In the chronic superficial block, the veins visualized are dilated and tortuous (Fig. 2) and the passage of the dye upward is usually slow. In films showing proper soft-tissue detail, numerous dilated, varicose veins in the superficial tissues which do not fill with the dye are frequently seen. The deep circulation is, of course, visualized and the deep veins may show some dilatation and tortuosity of slight degree. It is not uncommon for the upward passage of the dye in the deep veins to be slow. In the presence of chronic superficial block, small connecting veins can be seen extending inward toward the deep circulation or outward from the deep circulation for a distance of 1 to 3 cm. These veins appear to end abruptly in the tissues. With this pattern, as with acute superficial block, the dye occasionally turns abruptly inward toward the deep circulation or toward another area of the superficial plexus. Also, areas of superficial circulation are not demonstrable. The distinguishing characteristic of chronic as opposed to acute disease, whether in the superficial or the deep circulation, is the tortuosity of the veins and the considerable increase in their lumen. A very few cases have shown definite evidence of acute and chronic block at the same time.

Fig. 3. Acute deep block, showing normal superficial vessels and non-visualization of deep vessels.

It is perfectly possible to overlook an acute block in a leg showing a long-standing chronic block of considerable extent. Fortunately, the demonstration of the chronic block, its degree and extent, is of paramount clinical importance in selecting the type of therapy which will give the most benefit.

Referring again to the table, we find that in this series of 100 cases deep block was demonstrated 50 times. Of these cases, 11 were acute. In all 11 of these acute cases of partial or complete block of the deep circulation of the leg and thigh, definite evidence of acute block in the superficial circulation was also demonstrable. This adds evidence to the theory that deep, acute phlebitis originates primarily in the superficial circulation. In the pattern showing acute deep block (Fig. 3), there is no visualization of the deep cir-

culation of the part of the leg or thigh involved. This is also true of deep chronic block. How then make the distinction?

The evidence is to be found in the character of the superficial plexus carrying the dye. In the acute process involving the deep circulation, the superficial circulation presents essentially the same appearance as in acute superficial block: The veins are straight and not tortuous. Anastomoses are frequent and numerous. At one or more points in the superficial circulation, definite evidence of block is demonstrated. The dye usually tends to collect into the internal saphenous and finally passes upward to the femoral fossa by means of the internal saphenous. Occasionally, in this type of case, a superficial vein may be found to be partly outlined by the dye and a thrombus may be demonstrable in this vein. Again, with the acute deep block, a small amount of dye may get into a portion of the deep circulation and reveal a thrombotic process there. The patterns of thrombosis will be discussed later.

The pattern of the chronic deep block (Fig. 4) is the easiest to recognize of any venographic patterns which we have seen. The deep circulation is absent in whole or in part. The dye usually enters branches of the internal saphenous rather promptly, and by the time the region of the knee is reached, all of the dye is returning upward through that vein. The entire internal saphenous from the femoral fossa downward well into the leg is dilated and usually quite tortuous, and from the physiological standpoint the upward passage of the dye is considerably slowed. Coming off from the internal saphenous can be seen short lengths of communicating veins which fade out into the tissues. These veins are considerably larger than the usual normal communicating vein and are frequently very tortuous. In cases where this chronic deep block involves the leg alone, most of the dye returns by means of communicating veins above the knee to the femoral vein.

It is perhaps fortunate that this pattern of chronic deep block is easily recognizable. Patients with a complete block of the entire deep circulation of the leg and thigh are frequently the ones showing very large, dilated, superficial varicosities extending from the mid-leg upward along the inner portion of the leg, knee, and thigh. These veins are a temptation to any surgeon. The venogram shows that the tortuous, dilated vein is a main channel for carrying the blood flow upward to the femoral fossa. Clinical tests in this type of case may apparently demonstrate a competent deep circulation when the venogram shows none to exist. This type of leg should be treated conservatively. Radical measures will usually aggravate the condition.

Four cases in this series of 100 were considered essentially normal. Two cases in the series were inconclusive and in these no attempt at diagnosis was made. This percentage of inconclusive results is very much smaller than we expected or than we had in our first 100 cases.

TABLE II: PATTERNS IN FRACTURE, THROMBOSIS, AND WHEN PUDENDAL CIRCULATION IS VISUALIZED

FRACTURE	5
Acute deep block in leg	1
Chronic deep block in leg	1
Chronic superficial block in leg	1
Chronic superficial block in leg / Chronic deep block in leg	2
THROMBOSIS	2
Acute deep block in thigh	
Acute superficial in leg	1
Chronic superficial in leg	1
PUDENDAL	4
Chronic deep block of leg with acute and chronic superficial block	1
Chronic deep block of leg and thigh	2
Chronic deep block of leg and thigh with chronic superficial block of leg	1

In this series of 100 cases (Table II), examination was made five times in cases of fracture with persistent swelling of the leg. In all five of these cases, definite evidence of superficial or deep block could be demonstrated. In the total number of cases examined, other fractures have been investigated. In every instance where a fracture has occurred and a venogram has been made within a short time or within some months thereafter, evidence of block

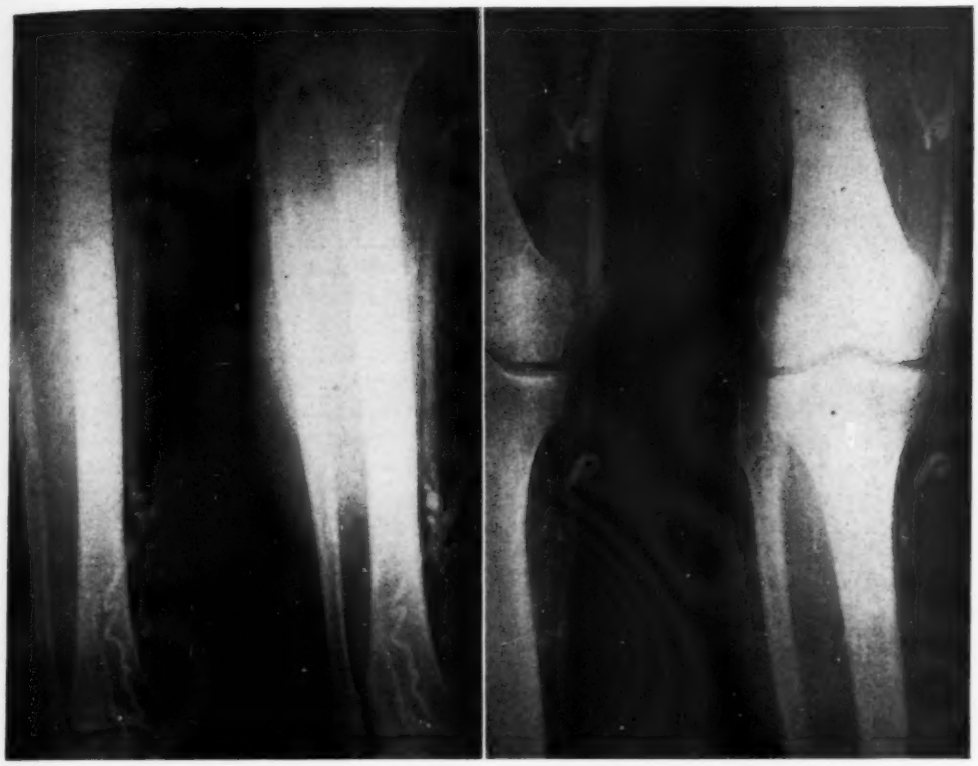

Fig. 4. Chronic deep block, showing dilated superficial vessels with blocked communicating branches.

could be demonstrated in the venous system. All of these cases have shown persistent edema.

In the 100 cases, two examples of definite thrombus were observed. The patterns of thrombosis as seen in our total series were of three different types. In the first type, we find a sudden block of a vessel. The head of the column of dye at the site of the block is concave and gives a definite impression that the lumen of the vein contains a mass that the dye is beginning to outline. The second pattern is one in which the vein is not completely obliterated but shows a ragged, irregular area extending for a short or longer distance along the wall. The third pattern is the one so well described by Bauer (4), in which the dye follows the wall of the vein and outlines a mass within the lumen.

In cases where the block has involved the external iliac vein, the dye returning from the leg to the body has followed four patterns. In this series of 100 cases, it will be observed (Table II) that the pudendal circulation has been demonstrated four different times. Of the four patterns mentioned, all have been seen in the total series. One of the types or patterns has been seen but once, and that in a case of acute deep block involving the upper femoral and external iliac vein. The dye proceeded outward from the upper portion of the internal saphenous in the thigh and extended into a network of superficial veins, gradually extending backward from the inner part of the thigh toward its posterior portion. In veins extending upward in this posterior portion the dye was lost. The other three types have all involved the pudendal circulation.

The second pattern is the one that is probably best known clinically. The dye comes out into the pudendal circulation

and spreads upward through anastomoses with the veins in the lower portion of the abdominal wall, and thus into the body.

In the third type of return, which has been seen several times, the dye comes out into the pudendal circulation in the region of the femoral fossa. It extends across the body, apparently in one of the branches of the pudendal circulation, which anastomoses with the pudendal circulation of the opposite side. The dye takes a retrograde course through this portion of the pudendal circulation to the opposite femoral fossa. At that point, it enters the internal saphenous and travels upward through the external iliac of the opposite side. This type of circulation has been seen in its entirety.

The fourth type has been somewhat more difficult to trace. The dye enters the pudendal circulation and its anastomoses with the peroneal veins, flowing backward and upward through the latter into the pelvis. Most of this dye appears to collect in a rather deep vessel lying somewhat anterior to the sacrum and running laterally in the posterior portion of the pelvis. This vein, which is of fair caliber, finally empties into the external iliac vein at the level of the lower portion of the sacroiliac joint.

A few further observations should be made in regard to the physiological return of the dye in the leg. We have tried elevating the head of the table so that the patient is at an angle of 15 degrees from the horizontal with the head up and the feet down. In this particular position in the normal case, the dye return seems to be approximately as rapid as with the patient completely supine. Where there is any slowing of the stream or any evidence of acute or chronic block, however, the upward passage of the dye is delayed very much longer than with the patient supine. We were unable to predict with any satisfaction the time that the passage of the dye would take in the pathological case. As a consequence, the visualization of the vessels in the thigh, and occasionally in the upper leg, was frequently poor or completely missed. Unsatisfactory visualization occurred in too many cases for continuance of this type of procedure.

With the patient in the opposite direction, the head down and the feet up, again with the table at an angle of 15 degrees from the horizontal, the upward passage of the dye showed no marked change as compared with the supine position. The practice was not continued because of the difficulty of maintaining the patient in this position for any length of time.

SUMMARY

We have presented a method of venography which in our hands has given practically complete visualization of the veins of the entire leg, thigh, and lower pelvis in *most* cases. The venograms are classified into types or patterns, indicating acute and chronic block of the superficial and of the deep plexuses. Three types of venous thrombosis have been observed and described. Four methods of abnormal venous return from the thigh to the body have been demonstrated. We believe that the procedure when properly done gives highly accurate information.

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The Antero-Posterior Lordotic Projection in the Roentgenographic Examination of the Lungs[1]

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THE CONVENTIONAL radiographic examination of the lungs, especially when supplemented by fluoroscopy and films taken in the oblique and lateral projections, is usually satisfactory for the demonstration of pulmonary disease. In some cases, however, additional examination of the apices is necessary. The importance of this special examination is emphasized by the fact that in a large proportion of cases tuberculous infiltrations are present in the apical and subapical areas. The importance of demonstrating a small infiltration, with or without cavitation, is obvious.

It is the purpose of this paper to describe the anteroposterior lordotic projection, by means of which the pulmonary apices may be better visualized than they are in the usual projections, and to render clear its usefulness. No claim is made for originality, since Fleischner (2) and, particularly, Lindblom (4) have used this projection and described its application in pulmonary disease. Cole (1) likewise has used this projection in the study of the pulmonary artery. The method of examination has been described in two of the manuals on technic which were available to us (5, 7).

Roentgenographically, the apical portion is arbitrarily designated as that part of the lung seen behind and above the clavicle in films taken in the postero-anterior position. There are many anatomic structures which are found in this region (3) and which contribute shadows which may be seen on the roentgen film. These are:

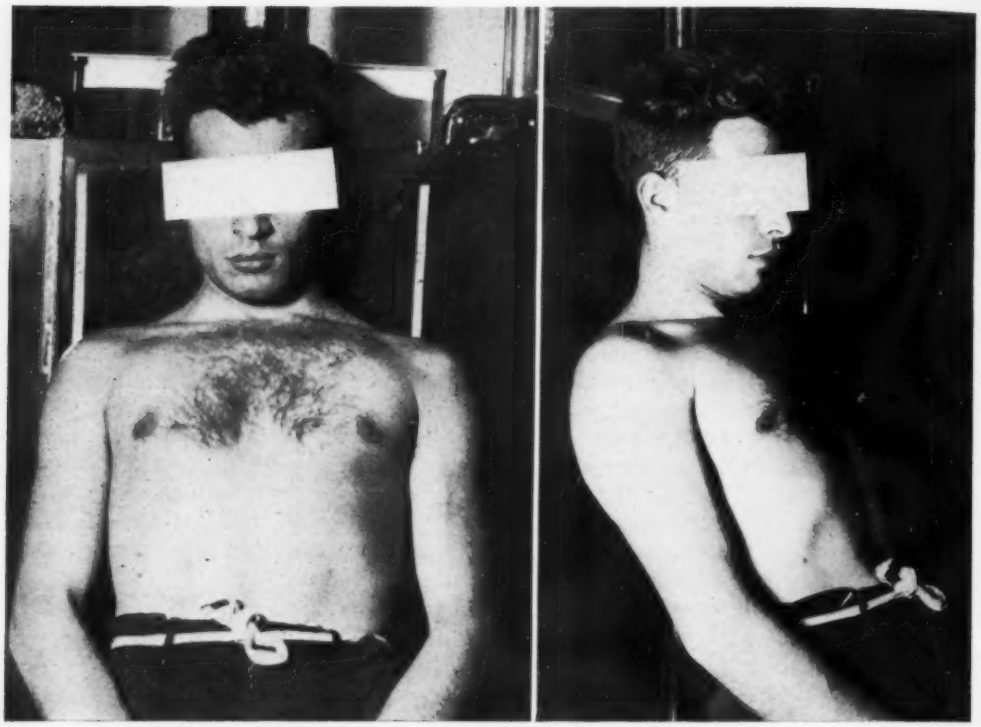
1. The skin and subcutaneous tissues.
2. A muscle group, consisting mainly of the sternomastoid, the scapular, and erector spinae muscles.
3. A vasculo-nervous sheath in which are included the subclavian vein, the subclavian artery and its branches, as well as some of the branches of the brachial plexus.
4. The clavicles, particularly, and to a lesser extent the posterior and lateral portions of the upper three or four ribs. These produce the most important obscuring shadows, especially if the film is slightly underexposed. The anterior portion of the first rib and its costal cartilage also contribute occasionally to the obscuration of the lung apices.

Various radiographic means have been employed to obtain clear views of the apices in those cases which present confusing or doubtful shadows. It has been suggested that the clavicles may be displaced either by elevation of the arms alone or by elevation of the arms plus elevation of the roentgen-ray tube and projection of the central ray of the roentgen beam 15 to 20 degrees caudally (6). The objection to the latter method is that in some cases it produces obliteration of the entire apex of the lung. Very frequently, too, only the lateral half of the clavicle is elevated and the mesial half, which is not elevated, prevents adequate visualization of part of the lung apex.

Examination of the chest in deep expiration (6) results in depression of the clavicles. Where good clavicular motion is present, a descent of 1 to 2 cm. may be obtained. Since motion of the clavicles depends on motion of the bony thorax, the value of this projection is limited where there is restriction in the movement of the bony cage either as a result of intrathoracic disease or because of an antecedent operation.

Another procedure is one requiring overpenetration of the film or exposure with

[1] From the Roentgenologic Service, Lovell General Hospital, Fort Devens, Mass. Accepted for publication in December 1943.



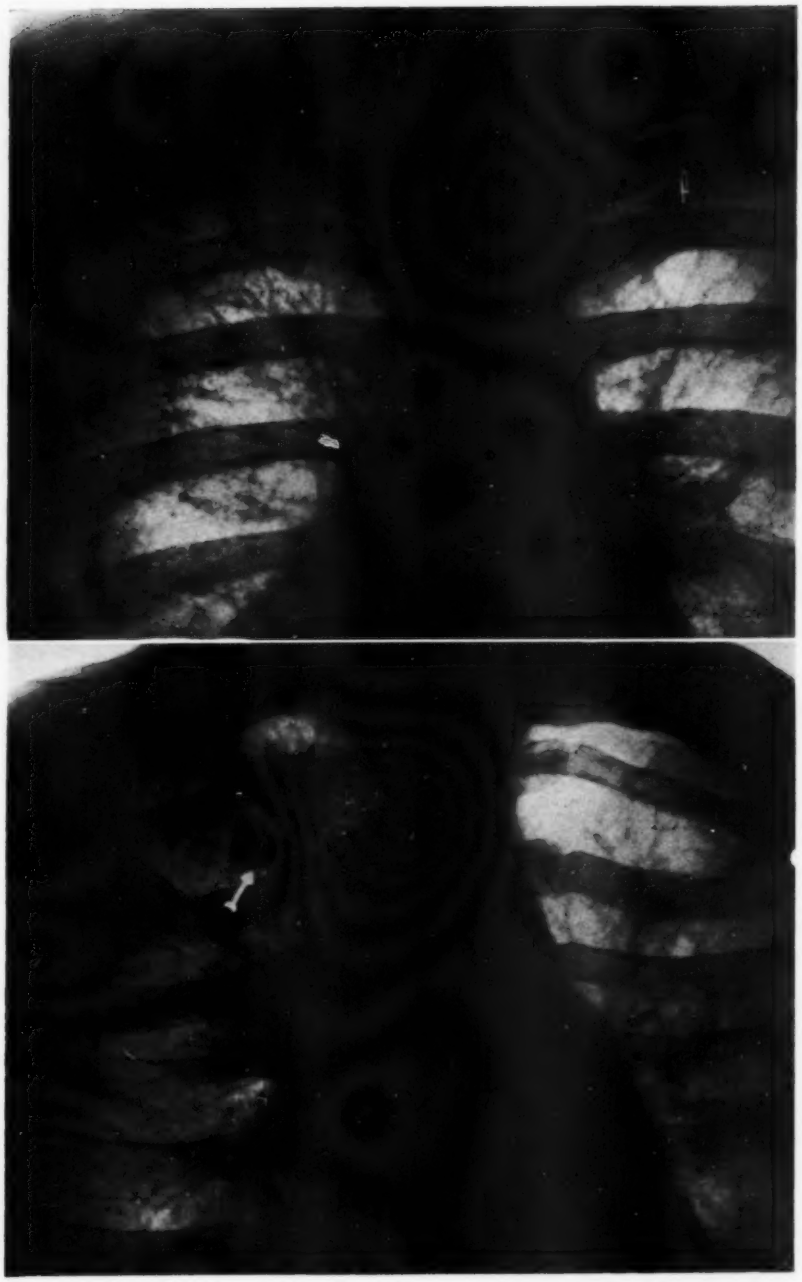
Figs. 1 and 2. Posture of patient for anteroposterior lordotic projection.

a Potter-Bucky diaphragm. Laminagraphy is still another method. These last three methods have definite value and are useful in detection of cavitation in a dense shadow. Laminagraphy has an unquestioned place and value in the investigation of pulmonary disease, but many feel that the use of the added number of films is unwarranted during the National Emergency. Moreover, in many installations a laminagraph is not available.

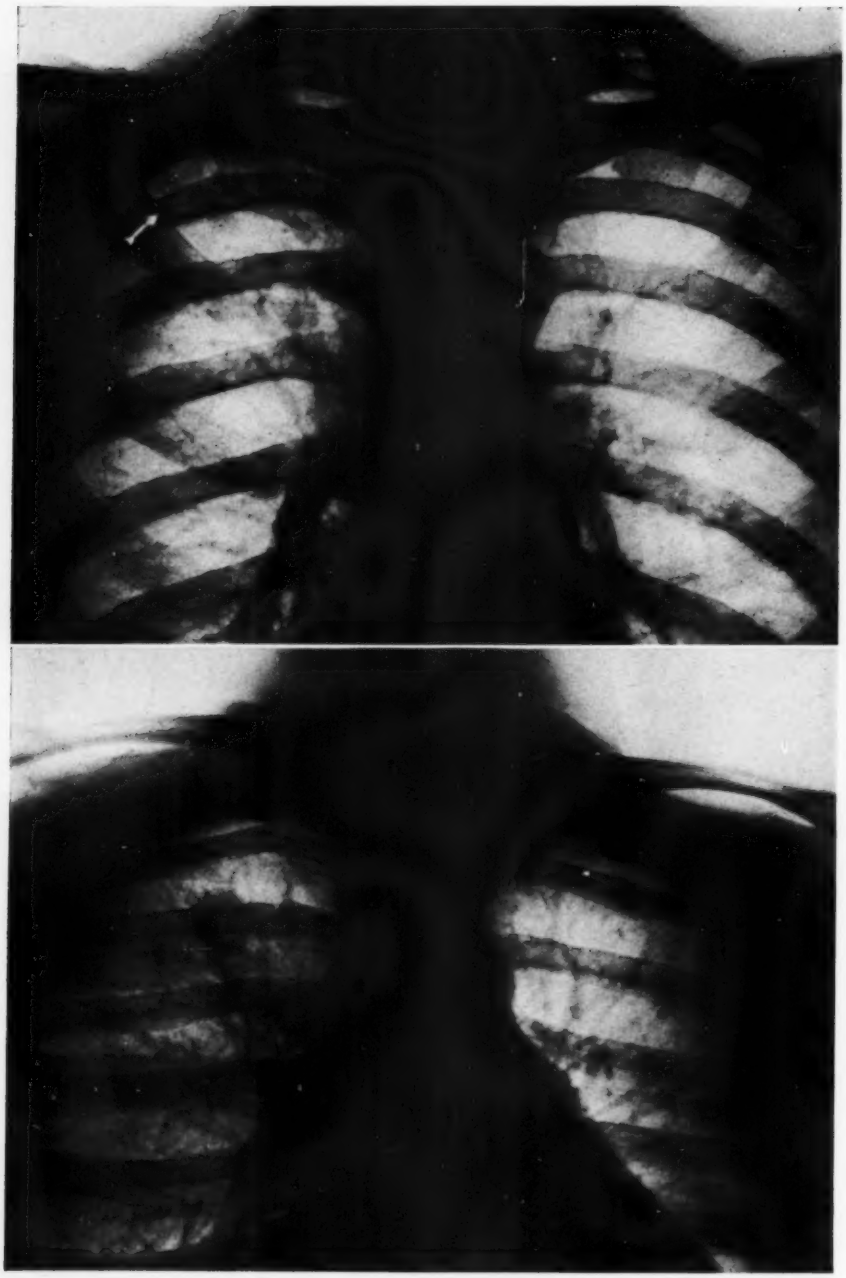
For some time, we have been using the anteroposterior lordotic position when special study of the lung apices is desired. This is a simple method and requires no special apparatus. The examination may be done rapidly and with the use of only one 10 × 12-in. film. The patient faces the roentgen-ray tube (Fig. 1) and, with the knees slightly bent and the abdomen protruding in extreme lordosis (Fig. 2), leans backwards against the cassette holder. The central ray is directed horizontally. The technical factors used are such that the exposure is twice that for the routine postero-anterior projection at 6 feet; or the same factors are used as in the ordinary examination and the distance is decreased to 4 feet. The lordotic position causes the clavicles to be projected upwards while the anterior portions of the ribs assume an approximately horizontal position.

It is true that small lesions situated in the most anterior portion of the upper lobes may be displaced and distorted unduly. We have, therefore, on occasion used other projections to demonstrate anterior lesions. In most of the cases examined by us, however, the anteroposterior lordotic projection has proved adequate.

This projection has been most useful and strikingly demonstrative in those cases in which there is only a suspicion of a shadow behind the clavicles or of an in-



Figs. 3 and 4. Case 1: In Figure 3 (above) there is a faint suggestion of several small infiltrations just beneath the mesial end of the right clavicle and within the shadow of the anterior extremity of the first rib. Figure 4 (below), the anteroposterior lordotic projection, shows infiltrations and a small cavity containing a fluid level (arrow). Notice the projection of the clavicles above the pleural domes and the horizontal position of the anterior extremities of the upper ribs.



Figs. 5 and 6. Case 2: In Figure 5 (above) a small indefinite infiltration is seen in the first right anterior interspace (arrow). This is partially obscured by a posterior segment of the fifth rib. The anteroposterior lordotic projection (Fig. 6, below) demonstrates a small cavity and several small adjacent infiltrations.

Figs. 7 and 8. Case 3: Routine film (Fig. 7, above) shows an infiltration obscured by the anterior portion of the left second rib and posterior portion of the fourth rib. Its ring shape suggests a cavity (short arrow). There is a faint suggestion of a shadow behind the anterior end of the first rib, obscured by the posterior portions of the third and fourth ribs and the mesial end of the clavicle (long arrow). The lordotic projection (Fig. 8, below) shows a large nodular lesion in the apex (long arrow) and also the cavity which was partially obscured (short arrow).

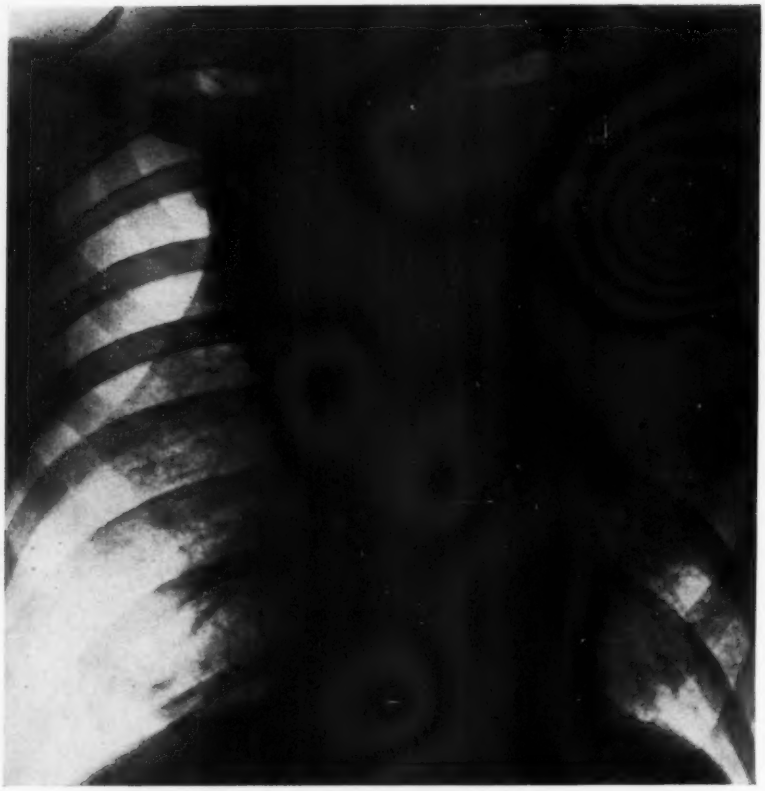


Fig. 9. Case 4: Bilateral tuberculosis. Status of right apical cavity not clearly determined. Apical adhesions are demonstrated.

filtration which is incompletely discerned. In Case 1 there was a suggestion of an infiltration in the right apex (Fig. 3). The lordotic projection (Fig. 4) demonstrated a definite cavity showing a fluid level and several small adjacent infiltrations. After the induction of pneumothorax therapy in this case, the lordotic projection was of great aid in following the course of the disease. In Case 2, a small infiltration was noted at the level of the first right anterior interspace (Fig. 5). The use of the lordotic projection (Fig. 6) demonstrated the lesion to be a small cavity with several small adjacent infiltrations.[2] In Case 3, the routine film (Fig. 7) showed an infiltration obscured by the anterior portion of the left second rib and posterior part of the fourth rib; there was a suggestion of another lesion obscured by the anterior end of the first rib and the posterior parts of the third and fourth ribs. Films taken in the lordotic position (Fig. 8) showed a small cavity at the level of the second left rib and, in addition, a large nodular infiltration in the apex of the lung. In Case 4, a cavity was demonstrated in the right apex and in the left lung. After induction of a pneumothorax on the right side, the apical region of the right upper lobe was obscured and the status of the cavity could not be determined (Fig. 9). The lordotic examination clearly indicated that the cavity was still not collapsed (Fig. 10).

It has been suggested that slight overexposure of the film may bring out lesions which may be obscured on the roentgeno-

[2] The lordotic examinations were done on the same day or the day following the routine examination with the 14 × 17-in. film.

Fig. 10. Case 4: Right apical cavity with fluid level clearly outlined and band adhesions clearly discernible.

gram made with the usual technic and that, if this practice were pursued in cases such as those mentioned in this paper, further examination using the lordotic position would be unnecessary. This is only partially true, since it is unlikely that the details of such lesions will be demonstrated if the obscuring shadows of the anatomic structures projected into the pulmonary apical region are not displaced. This can be accomplished only by means of the lordotic position or its modifications.

SUMMARY

The anteroposterior lordotic projection for the examination of the pulmonary apices is described. It is extremely useful in the detection and identification of small or inadequately visualized lesions in the apex of the lung. Several cases illustrating its value are presented.

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Neurosurgery and Radiation for the Relief of Pain in Advanced Cancer[1]

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ONCE A SUFFERER from a malignant neoplasm is referred to a roentgenologist, the latter should make the patient's future course a matter of constant concern. Particularly in the case of recurrent or metastatic growths, the important role played by radiation results in great dependence upon the radiologist for help and advice. This group of patients is one of the roentgenologist's greatest responsibilities and deserves his most considered judgment that no measure be overlooked that may prevent suffering and early drug addiction.

Sometimes the attitude toward metastatic cancer is unduly pessimistic. There is an inclination to put the patient on morphine and hope that the tumor will do its work quickly. We do not know enough about cancer to predict with any degree of certainty which tumors can be controlled. Percentage figures do not apply to the individual case. A patient with a controlled neoplasm, metastatic or not, is no more ready for the grave than a patient with controlled diabetes or a failing heart. Cancer, when there is any hope of amelioration, should receive enthusiastic attention and adequate radiation. Frequent good and occasional startling results follow. Bone regeneration and relief of pain and other symptoms may ensue, with comfortable life for months and sometimes years.

CASE I: In June 1933, H. J. G., a 63-year-old white carpenter, came to the University Hospital because of a small mass in the right scrotal sac. He had first noticed this fifteen months previously and it had been growing larger for two months. A right epididymo-orchiectomy with high amputation of the cord was performed promptly. The pathological study revealed an angio-endothelioma of the spermatic cord, and the amputation was through involved tissue. A course of x-ray therapy was given through portals covering the entire spine.

The patient led an uneventful life for over two years, at the end of which time pain developed behind the right eye, followed rapidly by diplopia, loss of vision, and proptosis. A clinical diagnosis of metastasis was made, and radiation was tried. Prompt recession of the eyeball and relief of pain followed, with gradual restoration of vision. The patient resumed his carpentry and a more active life than most men of 65 engage in. He is now 73. In spite of direct irradiation of the eye, it functioned normally until cataract formation set in. There is an early cataract in the left eye. The radiation, no doubt, hastened the development of the cataract in the right eye, but there has been no recurrence of tumor.

CASE II: J. M. B., a 36-year-old white housewife, mother of two children, had a radical mastectomy for breast carcinoma, followed by radiation therapy in the fall of 1932 at another hospital. Three years later, she was admitted to the University Hospital, incapacitated by severe pain in the left shoulder girdle and arm. The shoulder was greatly swollen. Motion was sharply limited and the arm useless. Even passive motion produced agonizing pain. All this had developed rapidly during the previous three months.

X-rays (Fig. 1A) showed destruction of most of the left clavicle and scapula. An aspiration biopsy was done, with a report of "metastatic carcinoma."

Radiation therapy was started at once. Within three or four days, pain was completely relieved. Within two weeks, the patient had partial use of the left arm. A roentgenogram made a few weeks later (Fig. 1B) shows the remarkable result, in so far as bone regeneration is concerned. More satisfying was the complete change from a pain-ridden cripple to an active, healthy woman.

Three months later, the patient was again seen, with extensive destruction of the lumbar vertebrae. Radiation again restored her to normal activity. From December 1935 to April 1939, this patient had one skeletal metastasis after another. Almost every bone, including the skull, was involved at some time. As the months and years went by, response to radiation became less dramatic, but until April 1939 she cared for her home and family. Four years and four months of active life were given her. By April 1939, active metastases were so widespread and the tumor so resistant that nothing more was attempted and death occurred three months later.

[1] Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–2, 1943.

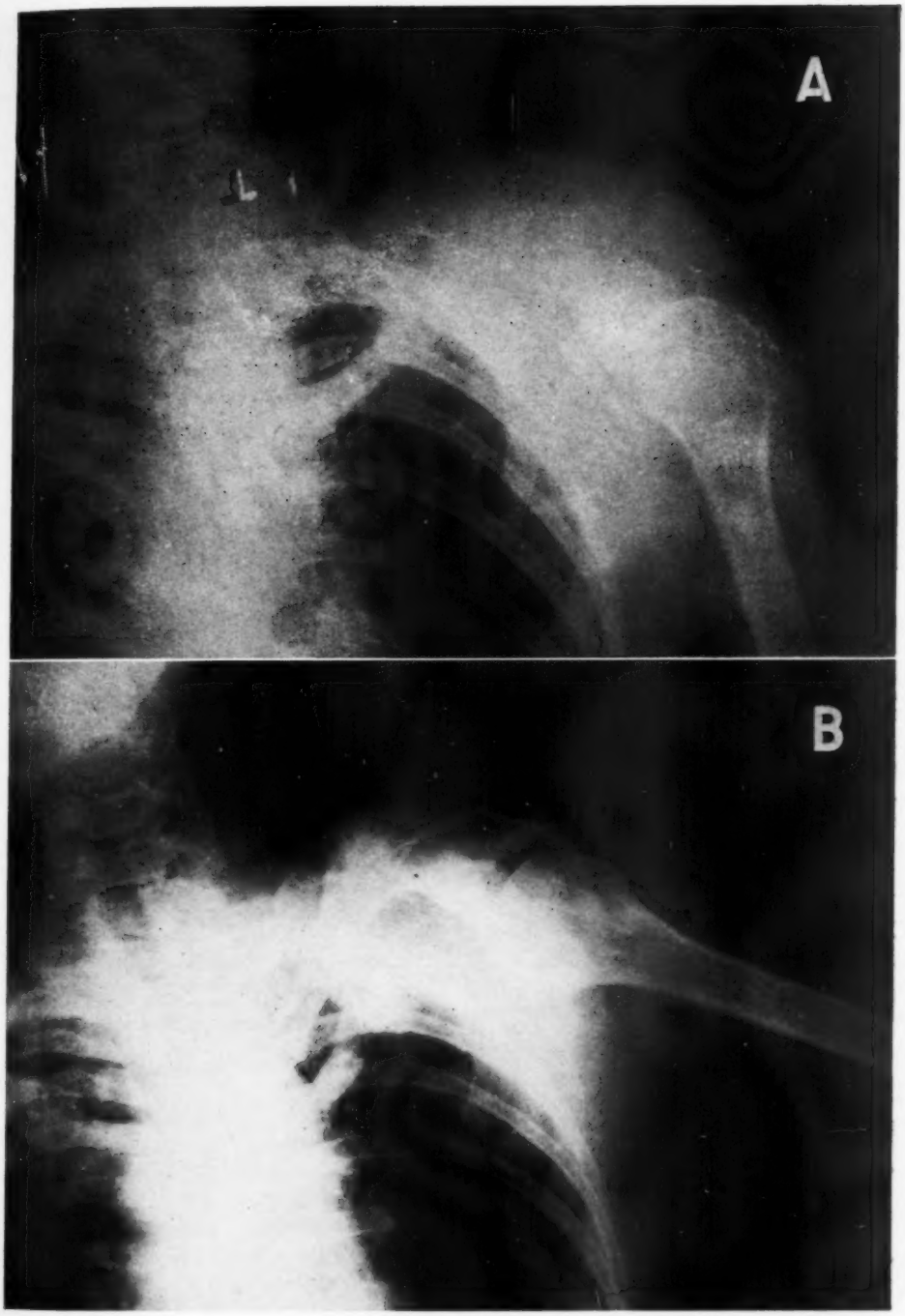

Fig. 1. Case II. A. Destruction of left clavicle and scapula by metastatic cancer. B. Bone regeneration following irradiation for relief of pain.

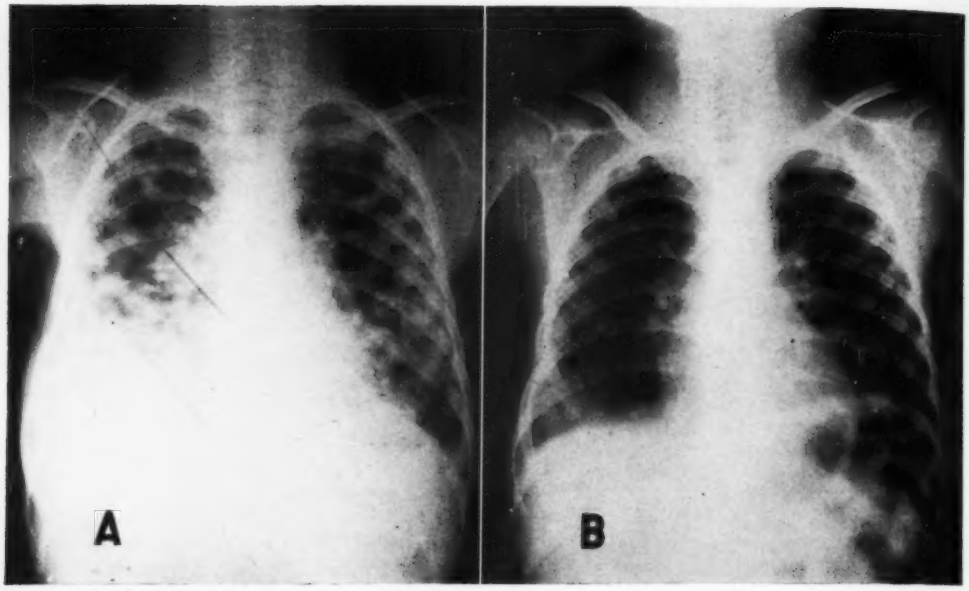

Fig. 2. Case III. A. Extensive pulmonary metastases from an atypical Ewing's tumor. B. Clearing of lungs following irradiation.

In connection with this patient, it should be pointed out that it is the roentgenologist's responsibility to see to it that the orthopedist is called in when bone metastases have produced danger of pathological fracture. Caution in the use and handling of the weakened parts and the application of supporting braces can prevent fractures of the extremities and crushing deformities of the spine until radiation has had its effect.

CASE III: This is the most remarkable case history in our records. In July 1932, the parents of a 6-year-old white girl, D. S., brought her to the Out-Patient Department because of the presence of a tumor of the chest wall. This tumor was in the right nipple line over the seventh and eighth ribs, it had been present three months and was then 2.5 inches in diameter and growing rapidly. It was slightly tender. The child was restless and sleeping poorly.

X-rays (Fig. 2A) showed the lungs riddled with metastases and an area of destruction in the right seventh rib, marking the site of a primary bone sarcoma. A biopsy of the mass (later reviewed by Doctor Ewing) was the subject of much discussion. Finally a diagnosis of an atypical Ewing's tumor was decided upon.

At the time of the child's first visit, it was felt that the disease was too advanced for irradiation, and she was sent home without treatment. Ten weeks later, the parents brought her back. The external mass had reached a diameter of 6 inches and the child was *in extremis*. She had a high fever, rapid, thready pulse, and was cyanotic and cachectic. Hating to dismiss the parents without doing anything, we gave two doses of 600 r on successive days to the entire thorax and sent the child home to die. To our utter astonishment, she walked into the hospital with her parents five weeks later, a vigorous, healthy child. Figure 2B shows what had happened. Two more x-ray treatments of 600 r were given.

This patient is today a perfectly normal young woman and has been married a year. Figure 3 is a reproduction of her latest chest plate. The rib deformity is the only residuum of her disease.

Persistent pain in a patient with a known malignant neoplasm should be regarded as evidence of metastasis, whether it can be confirmed by roentgenographic evidence or not. Pain due to metastasis frequently precedes demonstrable changes. X-radiation at this point alleviates suffering and prevents deformity due to bone destruction. Other possibilities can be investigated during the period of roentgen therapy. Waiting to irradiate until de-

struction has taken place simply prolongs the period of suffering for the patient and increases the chances of pathological fracture.

CASE IV: W. M. T., a 35-year-old white housewife, had a right radical mastectomy done elsewhere in February 1935 because of a breast cancer with axillary and supraclavicular metastases. She was referred to our department for postoperative x-ray therapy. A routine course was administered to the local areas, and x-ray sterilization was done. (We believe that there is definite evidence that sterilization is beneficial, at least in some cases, but as of the present we prefer surgery for this purpose, on account of the possible interstitial-cell reaction, which is unaltered by radiation.)

The course was uneventful for three and a half years. In July 1938, the patient began suffering with pain low in the lumbar region. X-ray examination was negative for metastases. Her physician then decided she was suffering from arthritis, and a hunt for foci of infection was started. Within three weeks, the pain had become rapidly worse, and x-ray treatment was given to the lower lumbar spine, on a presumptive diagnosis of metastasis. Relief was prompt and complete. Two months later, the patient was back with pain in the upper lumbar region and cervical spine. On this occasion, bone metastases were found in the body of the twelfth thoracic vertebra and several cervical bodies. The lumbar spine was still negative. Undoubtedly, the lower lumbar pain had been due to metastasis, the progress of which was aborted by radiation before bone destruction developed. We could have saved this patient three weeks of pain if we had insisted on irradiating the lower lumbar spine when she began to complain. Three weeks less of pain would have meant a great deal to her. We were able to control the cancer for only a few months. Pulmonary metastases as well as extensive skeletal metastases developed and death ensued, after much suffering, in a year.

In the fight against pain due to advanced cancer, the radiologist and surgeon have a valuable ally in the neurosurgeon. His help should be sought promptly. The relief afforded by nerve injections, root sections, and cordotomies is dramatic. These measures are not, of course, applicable to all patients, and they carry a certain risk. The decision as to which procedure, if any, should be undertaken rests with the neurosurgeon, but the roentgenologist must see to it that his patients have the benefit of proper consultation whenever he thinks there is a chance of help from another

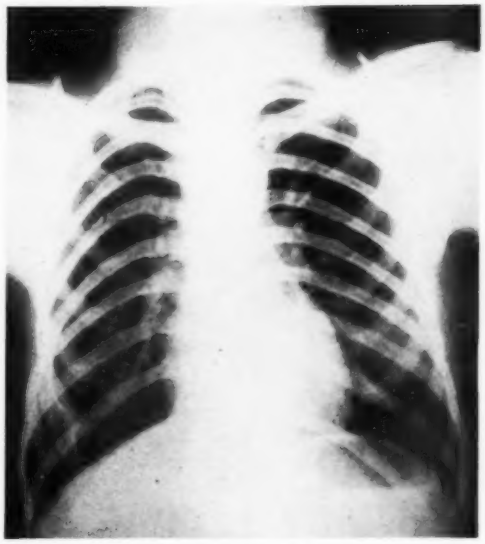

Fig. 3. Case III: Patient shown in Figure 2, thirteen years later.

quarter. Obviously, a patient who has only a few weeks to live should not be subjected to useless surgery of a fairly radical nature, nor should an elderly person whose pain can be controlled by small amounts of opiate undergo the hazard of operation. Often the decision is a difficult one, but it would seem preferable in doubtful cases to proceed with surgery, for there is so much to be gained and comparatively little to be lost.

CASE V: W. M. O., a 75-year-old white man, presented himself in March 1943, with an extensive carcinoma of the tongue (epidermoid, grade III). The tumor had been present for nine months. It was a bulky growth involving the entire tongue; there were metastases in the regional nodes, and the patient was suffering agonizing pains in the tongue and left side of the face, jaw, and neck.

X-ray therapy resulted in only partial relief of pain. The nodes melted away and the tumor was reduced by one-third, but it was still too extensive for radium implantation.

On July 9, 1943, the mandibular branch of the left fifth nerve was injected with novocaine and 1 c.c. of alcohol. A second injection was necessary several days later because of reappearance of pain in the auriculo-temporal branch of the mandibular nerve. A perfect result followed. Sectioning of the nerve root was therefore attempted, but the patient reacted badly to anesthesia, and the procedure could not be completed. However, though

the tumor is again growing, he is still comfortable three months later and does not require any medication for pain.

CASE VI: R. W. C., a 50-year-old white man, was referred to our department from another community for irradiation of a thoracic tumor. Exploration of the right thorax two weeks previously had revealed a large mass arising from the right side of the mediastinum and adhering densely to the second, third, and fourth vertebrae and ribs posteriorly. The operator felt that the tumor was too vascular for biopsy, so a pathological diagnosis was never made. The patient was suffering with severe pain just below the right nipple. In hope that the tumor was radiosensitive, x-ray therapy was administered. There was no response in six weeks. Therefore, the posterior roots of the right second, third, fourth, fifth, and a portion of the sixth thoracic nerves were divided intradurally. Relief of pain was complete. The patient lived only three months, but without suffering.

CASE VII: S. K., a 47-year-old colored man, when first seen in September 1938, had been passing bloody urine and clots intermittently for six months and had been bleeding continuously for six weeks. Cystoscopic examination revealed flat tumor fronds around the internal urethral orifice, a small sessile tumor in the center of the trigone, and a large papillary tumor near the left ureteral orifice. The tumors were resected and fulgurated. The pathological report was papillary carcinoma, low grade I.

During the next few months, recurrences were resected and fulgurated at monthly intervals. Since he was comfortable and had no bleeding, the patient refused further attention for a year. When he began passing blood again, he returned. Multiple tumors were removed. Still stubborn, the patient stayed away twenty-one months, until more blood appeared in his urine. This time, the bladder walls were packed with small papillary tumors. One was removed for examination. The pathological report was still epidermoid carcinoma, low grade I. As resection and fulguration were impractical, deep x-ray therapy was tried. Because of the low grade of the tumor, irradiation was carried to the limit of tolerance, 18,000 r in air being given in a ten weeks' period. In two months, intractable pain had developed in the left hip and down the lateral aspect of the thigh to the ankle. From the subsequent course, it is fairly certain that fibrosis around the sacral plexus, secondary to the intensive irradiation, was the cause of the pain, rather than metastasis, though the latter was suspected at the time. The neurosurgeons were called in, and they did a laminectomy of the third and fourth thoracic vertebrae, incising the anterolateral column of the cord at two levels. Relief of pain was complete. This was in February 1942. At cystoscopic examination in March, only two small tumors remained in the bladder. These were fulgurated. The patient has learned his lesson and comes in regularly for check-ups. Every month or two another recurrence is resected and fulgurated, and he is getting along nicely.

When considering the advisability of neurosurgery, the possibility of unpleasant results must be weighed. Loss of sensation, loss of sphincter control, and paralysis are ever present dangers, and the pain should be more difficult to live with than the possible complications before they are risked.

CONCLUSIONS

1. Advanced or metastatic cancer is not a signal to bring on the opium and abandon hope. A few tumors can be arrested indefinitely, some for years or months, and many patients can at least obtain relief of pain from irradiation or neurosurgery.

2. Pain, whether metastasis is demonstrable or not, is an indication for radiation in patients with a known malignant tumor.

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The Ureter and Its Involvement in Pelvic Irradiation[1]

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THE URETER MUST be considered a vital structure. Its damage often results in a life-taking series of events. When total ureteral obstruction has existed for more than a few weeks, irreparable injury to the kidney results. If both ureters are involved and operative drainage of the urine is not quickly provided, the patient's life will be sacrificed.

The writer claims no originality in discussing the ureteral complications of irradiation therapy of the uterine cervix. Among others who have dealt with the subject are Herger (1), Schmitz (2), Bugbee (3 and 4), Matusovszky (5), and Colwell (6). The animal experiments of Martin and Rogers (7 and 8) indicate how seriously the ureter can be affected by doses of radium that appear to be small compared with a cancer dose, though the time factor in their studies was, of course, relatively short.

While the literature on ureteral-renal injury would seem to prove that it is both frequent and serious and is recognized as such by many close observers, little has been published on ways and means of controlling the lethal effects of such damage secondary to irradiation of the pelvis. When a patient with a pelvic cancer or fibroid is referred or comes directly to the radiologist for therapy, we may ask the question: "Who is responsible for the after-care of the case, when the x-ray or radium treatment has been concluded?" Since conditions related to the work of the radiologist may develop later, it would seem to be his duty to keep the patient under observation for a long time. It is his responsibility to anticipate all possible post-irradiation effects and to care for these personally or see that proper treatment is carried out by others. The need for such after-care is believed to be frequent.

As an example, mention may be made of a patient under the writer's care at the present time, with moderate obstruction of both ureters following treatment of a uterine fibroid four years ago. The fibroid, when treated, was about the size of a three months' pregnancy. The patient refused surgery, and the pelvis was irradiated with a total skin dose of 3,000 r delivered through several ports. Menorrhagia ceased and the tumor was reduced in size. At the present time a check-up of the patient shows a blood pressure of 160 systolic and non-protein nitrogen 42 mg. per cent. A No. 6 catheter is a tight fit for the ureters, but it is expected that dilatation will produce improvement. In this case the shrinking fibroid has probably caused extrinsic pressure on the ureters. The x-ray dose given would hardly seem sufficient in itself to produce any injury.

In some cases the ureters are already being compressed mechanically by the growing neoplasm before treatment is begun. Rarely cancer may actually invade the ureteral wall. Usually the ureter is caught in the healing fibrosis after intensive intrapelvic irradiation. That obstruction of greater or less degree often follows surgery in the deep pelvis is well known. A paper on this subject, therefore, seems timely both for the purpose of creating helpful discussion and also of suggesting a routine which has been successfully used by the author.

It is doubtful if surgeons make a practice of checking the ureters after pelvic operations involving trauma close to the ureterovesical junction. It is probable, however, that serious interference with the patency of the ureters follows treatment of cervical cancer with radium far more often than it follows surgery in the same area. Pohle

[1] Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–2, 1943.

writes: "In taking care of patients afflicted with carcinoma of the cervix, particularly the more advanced cases, one should always remember that the natural termination is usually due to uremia from occlusion of the ureters."

At times, some ureteral obstruction will be found by routine cystoscopy and catheterization before treatment is instituted If this obstruction is due to pressure by the tumor, treatment designed to reduce the mass may relieve the block. While this would seem natural, it rarely happens. It is felt that stricture of ureters in radium-treated cancer of the cervix is due rather to compression by scar tissue than to actual contracture of the ureter itself. The ureter lies, rather loosely, directly under the peritoneum. It is easy for a centralized area of scar tissue in the prevesical area between the ureters to draw them together at this point. The surrounding scar tissue, exerting pressure centrally on each ureter, closes its lumen. In a case to be described below, an autopsy showed this actually to have taken place. When the fibrous band about the ureters was cut, a fairly good opening was found through each, though some fibrous contracture had taken place within the walls.

Taking this matter of the possibility of ureteral-renal complications more seriously and adopting a routine after-care will result in an encouraging reduction in the mortality of radium-treated cancer of the cervix. We must admit that in recent years published statistics of adequately treated cervical cancer have not shown much further lowering of mortality. It would seem proper to suggest that we can perhaps improve those statistics by preventing some of the deaths which are due to uremia and associated conditions following pelvic irradiation. It is stated that many such deaths are occurring and that frequently nothing has been done to prevent post-irradiation ureteral obstruction. Of treated patients who do not survive five years, how many die with a ureteral injury as a primary or contributing factor?

Inquiry has led to the impression that routine cystoscopic and pyelographic studies of these patients, with subsequent treatment, are seldom done. In some instances the patient is followed for a few months subsequent to the treatment course. The condition of the vagina and the skin is noted, and that is all. Unless the patient gives a typical history of ureteral obstruction and renal colic, she is dismissed.

Patients vary greatly in their interpretation of symptoms. Cases of ureteral obstruction may go on to uremia without the classical backache and radiating loin pains we have been told should first be observed. The fact is that a slowly occurring ureteral obstruction is often symptomless until uremia has developed, when it is usually too late to save the patient's life. Such a case was the cause of the writer's perhaps unusual interest in this complication.

A woman of 43 presented herself with a cervical cancer of squamous-cell type, grade 2, stage 2, arising in a cervical tear on the left. Her general health was excellent. Deep x-ray therapy through five ports was instituted. Doses of 500 r divided between two ports were given daily until a skin dose of 8,000 r had been administered (Thoraeus filter; 200 kv.). Within seven days the cervical lesion was clearing up and within ten days radium therapy was begun. Fifty milligrams of radium element, filtered through the equivalent of 1.0 mm. platinum and 1.0 mm. rubber, was applied: 10 mg. within the fundus of the uterus, 20 mg. within the cervical portion, and 10 mg. within each vaginal fornix. A total dose of 7,674 mg. hr. was thus given.

The woman was examined several times following completion of the irradiation. The external skin showed only a moderate reaction. The cervical cancer melted away and the usual resolution took place. The cervix became obliterated and the vaginal fornix contracted, as usual, with moderate redness. There was very little pelvic pain or cystitis. For perhaps six weeks there was a mild enteritis, which responded to a low-residue diet and sedative medication with bismuth and paregoric.

After the eighth week the patient made no further complaint. At the end of nine months, without any history of backache, loin pains, or bladder disturbances, she began for the first time to complain of headache. In seven days nausea developed, and the patient was hospitalized for study. The nonprotein nitrogen was found to be 73 mg. per cent and the urinary output was greatly reduced. Cystoscopy showed the bladder to be moderately red, as in many women in the menopause. The ureteral orifices were easily found and catheterization was

attempted, only to meet with a solid obstruction at about 3 cm. The left ureter would not even take a filiform, but after some effort a No. 5 catheter was passed on the right. This was left in place for twenty-four hours—after which it became blocked, as usually occurs—and 500 c.c. of urine was obtained. The catheter was then removed for cleaning and it was impossible to reinsert it. The patient was treated by sweating and the usual measures for uremia. The non-protein nitrogen increased to 90 mg. per cent within twenty-four hours and a surgical consultant advised against operation. Death occurred within three days with a non-protein nitrogen of more than 150 mg. per cent. The patient's husband stated that, until ten days before her death, she was doing all her own housework and appeared to be very well.

Autopsy showed moderate distention and cloudy swelling of both kidneys. The ureters were moderately dilated and patent down to the cervical area. At this point they were drawn together into a firm rounded mass, 3 cm. in diameter. This mass was removed and sectioned. No cancer cells were found within it, nor was there any involvement of the adjacent lymph nodes.

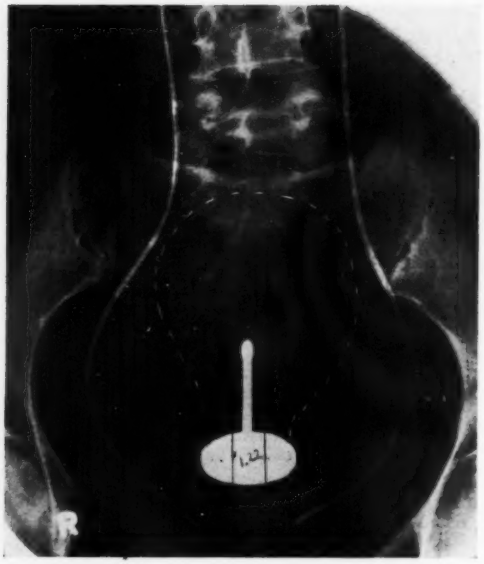
The total lack of symptoms of ureteral block in the foregoing case, until uremia had developed, caused the writer to investigate a number of other cases recently treated. As a result, a program of ureteral care and observation was set up which has been followed since that time. The absence of a urologist made it necessary that the urological work be done by the writer. No doubt many others, under war conditions, will find it necessary to do likewise, especially as the frequency with which the urological observations should be made renders it impractical to send the patients to some distant urologist. In the writer's case the desire to work out the problem for himself was an added incentive. The routine technic is as follows.

TECHNIC FOR MAINTENANCE OF URETERAL PATENCY

No particular preparation of the patient is necessary except a sedative (3 gr. nembutal) an hour before cystoscopy.

The urethra and introitus are painted with mercurochrome. The cystoscope is well greased with nupercain ointment, dipped in glycerin, and inserted. At times preliminary dilatation of the urethra with graduated sounds is done. It is believed that application of nupercain ointment to the catheter makes it slip along with less trauma and gives some sedation. Though both ureters are often checked at the same time, only one catheter is ever left in for any length of time. Some ureters swell after the catheter is withdrawn, and having both closed off even for a few hours is an unpleasant experience. Usually an opiate, hypodermically, is needed following cystoscopy. A bottle of coca-cola is given to encourage diuresis. With the catheter in place, the patient is kept on an out-of-the-way clinic table for two or three hours and then sent home, walking at least to the waiting car or taxi. Sulfathiazole, 15 gr. t. i. d., and a few sedative tablets are routinely given. Occasionally, but not often, a hypodermic is needed after the patient reaches home. By this plan the cost of hospitalization is kept down, which is often of great importance.

As a result of this routine, it has been possible to keep the ureters open in almost all cases. The preliminary cystoscopy and pyelography give useful information about the bladder and the pre-irradiation condition of the urinary tract. This may be of great help in subsequent follow-up cystoscopies. It is felt that when the ureters are within normal limits in the first place, they can be kept open. If a stricture is allowed to develop that will not admit a No. 6 catheter, the trouble is serious. The ureter may be *kept open*, but it cannot be opened up after it has once been allowed to become smaller than this. When the reduction of the lumen passes this point, the catheters become plugged up when left in and, because of their small size, tend to stick into the ureteral wall and cause additional trauma. Such trauma will defeat the primary purpose of catheterization—*i.e.* opening up permanently the partially closed ureter. With the use of sulfathiazole routinely as a prophylactic agent, infection has been uniformly absent. Forty-five grains daily is given for the first three days, then half this dosage for the next three days. Unless the case is



Film 1. Typical female pelvis with ureteral catheters and pessary and lead disk in place. The approximate position of the uterus is indicated in this and succeeding films by a broken line.

complicated by a previous infection, this is usually sufficient. Increase in fluid intake is advised. In cases showing little or moderate obstruction, the intervals between catheter dilatations may be six weeks or longer during the first year. In most cases the procedure has been about as follows: primary cystoscopy and ureteral calibration during the first three weeks of irradiation, with dilatation if required; repetition of cystoscopy after successive intervals of six weeks, four weeks, eight weeks, and three months, with final cystoscopy, if things seem to be going well, at the end of the first year after treatment.

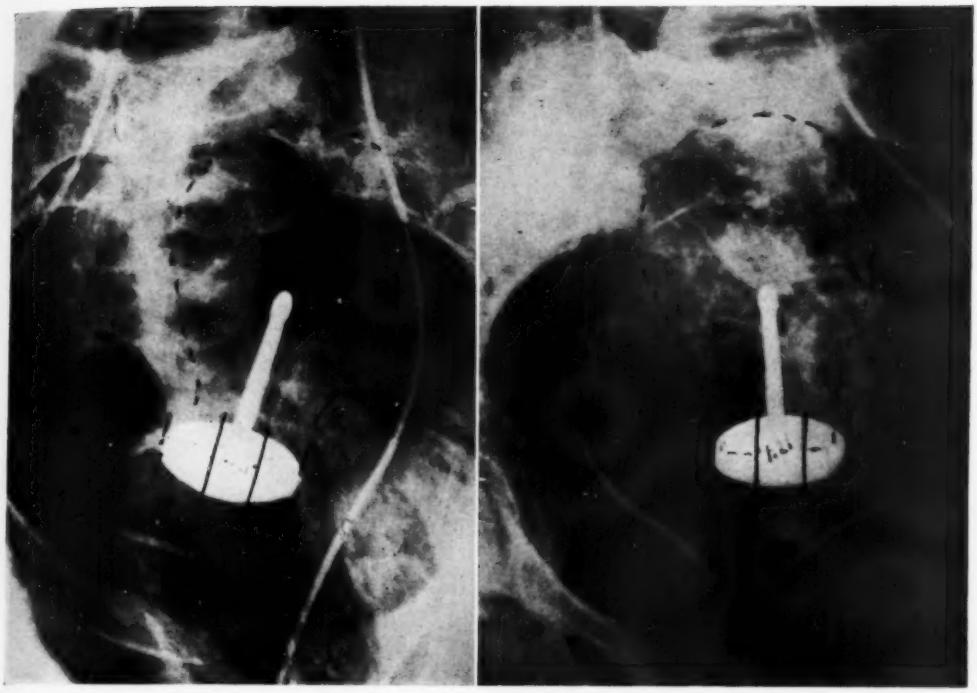
After considerable experience, it has been found that when the ureter is snug for a No. 6 catheter or tight for a No. 7, less trauma and better end-results are obtained if, instead of using a No. 7, a No. 6 is built up with melted wax over a distance of about 4 cm. some 18 cm. from the tip. In this way the entire ureter is not greatly disturbed and the actual dilatation is confined exactly to the strictured area, which begins 2 cm. inside the vesical orifice.

This may appear to be a lot of work, but with proper set-up it should not be burdensome. After all, what is the use of irradiation if the patient is to be lost through failure to prevent complications? In the average case about fifteen minutes is required for the cystoscopy. A nurse can handle the case after that. Pyelography takes a bit longer, but is done only once, at the beginning. Arrangements are usually made for some friend or relative to see the patient home. In cases in which serious ureteral obstruction is found, hospitalization is, of course, required for a few days. In actual practice, the writer has seldom found this necessary.

One warning should be repeated, as it is of the utmost importance in this work. *Do not wait for symptoms of ureteral block to appear before doing something to prevent the same.* It is comparatively easy to keep the ureters open but quite another problem to open them up after stricture is established. The ureter is a delicate structure, and the trauma from very small catheters, when these are all that will pass, is vastly greater than the trauma when a fairly large whistle-tipped catheter can be inserted. The early primary cystoscopic catheterization is important. It is believed that the catheters should be left in a few hours even when the ureters are found to be normal in size, to help straighten them out. This makes subsequent catheterization easier, when mild degrees of contracture in the ureters, rather than their natural curves, may have to be overcome.

Cystoscopy and repeated ureteral catheterization call for fortitude on the part of the patient, as well as co-operation. It has been found, however, that patients will co-operate when the importance of this measure is explained to them. Every woman has a horror of a cancer death. It may be that if we took more time to explain to our patients what they are up against, and what we are trying to do for them, they would always co-operate.

The author has made film studies of the ureters in a considerable number of women. Most of these studies have been incident



Films 2 and 3. Right and left oblique views of pelvis shown in Film 1.

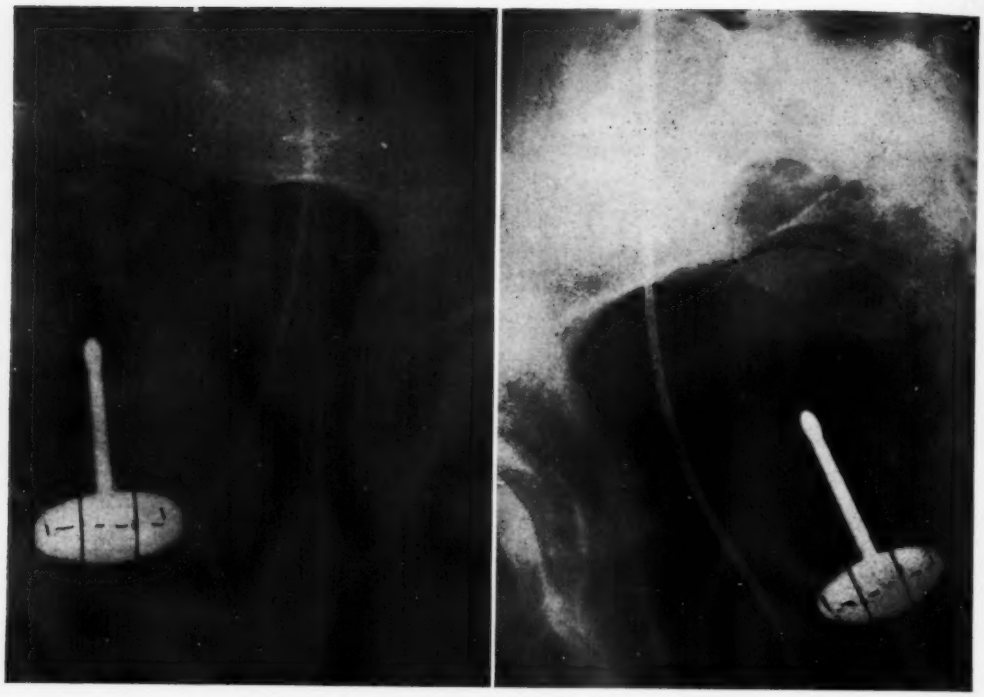
to cancer of the cervix. They suggest that the pelvic portions of the ureters show very little deviation in relation to the cervix.

For these studies an aluminum stem pessary, over which was fitted a thin lead disk measuring exactly 3 cm. in diameter, was inserted into the cervical canal with the face of the disk against the face of the cervix. Examination by the finger and speculum, after several such placements, showed the disk wall in place after the films were made. Usually light packing was used to insure the disk remaining in position, but no notable difference was noted in the same pelvis, with or without packing. Most pathological cervices have largely lost their normal mobility anyway. The radiographic measurements indicate that in most women the ureters lie within 1.5 to 2.0 cm. of the rim of the cervix.

Film 1 is that of a typical female pelvis with ureteral catheters and the cervical measured disk and pessary in place. The wide swing of each ureter as it enters the pelvis is shown, as well as the approach closer to the cervix as the ureter swings back toward the midline and starts forward to the floor of the bladder. The face of the pessary, which as before stated measures exactly 3 cm. in diameter, has been divided into three parts. Each third, as a measured distance on the film, represents 1 cm. fairly accurately. The cervix lies immediately cephalad or against the cephalad side of the measured disk. It is readily seen in this view that the cervix is within 2.0 cm. of the ureter.

Film 2 was taken in the right oblique position. The more distant ureter of the two is within 2.0 cm. of the rim of the cervix. Effort is now being made to see how far the ureters can be thrown away from the cervix, as represented by the metal disk. Film 3 is taken in the left oblique position. On this film the more distant of the two ureters is approximately 2.5 cm. from the rim of the cervix.

Film 4 and 5 are of a different case.



Films 4 and 5. Oblique views of another pelvis, showing ureters closer to the rim of the cervix.

Only oblique views are shown. It was found that the oblique positions usually show the ureters farther away. It will be noted in this case that they are closer to the rim of the cervix than in the patient shown in Films 1–3.

Film 6 is one of the many lateral views studied. In this position one may see how the ureters, after dropping off the sacral promontory into the pelvis, suddenly rise at the level of the cervix, travel anterior on each side of the cervix to the bladder floor. The sharp angulation of the ureter, shown on this film, no doubt adds to the difficulty of passing the catheter through this area, when pathological stricture has occurred following irradiation of the cervix.

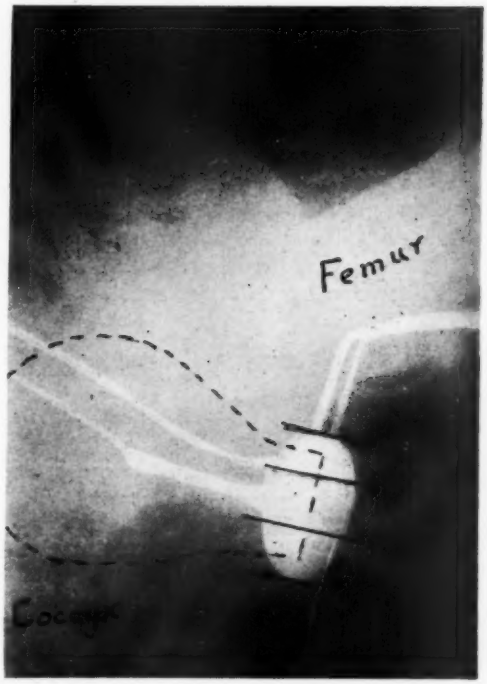
Mention has been made earlier in this paper of the desirability of early catheterization, to "straighten out" the normal angulation of the lower ureter. Film 6 shows the angulation referred to. It is thought that the size 6 or larger catheter, which has enough body to offer some definite resistance to angulation, helps to loosen up the severe angulation at this point when left in place for a few hours.

It must be realized that the normal ureter all along its course has a certain degree of mobility, as it lies directly under the peritoneum. The measured cervical pessary used in taking these films is magnified on the films in the same proportion as the adjacent anatomical structures. It would seem reasonable to assume that the distances, in centimeters, at the level of the cervix, as shown in these film studies, are fairly accurate. The approximate shape and position of the uterus have been indicated in the film by an interrupted line.

A word may be added regarding the procedure after it has been found that one or both ureters are irreparably blocked in the area of the cervix. If one ureter alone is involved, while the other shows unimpaired patency with normal kidney function, and sufficient time has been allowed to indicate that no further narrowing of

the good ureter is probable, a nephrectomy on the involved side is indicated. If both sides show more or less involvement, so complete on one side that marked impairment of function has resulted, and dilatation has not helped, then the more severe side may be surgically treated by bringing the ureter out through the abdominal wall. It is said that recent improvements have made such a permanent drainage of urine fairly comfortable for the patient.

It must be realized that three or four weeks of complete obstruction will permanently ruin the average kidney. Some surgeons have cut the ureter at the point of pelvic obstruction and transplanted it into the bladder. This is admitted to be a difficult procedure. In discussing this question with genito-urinary surgeons, I have been told that the transplantation of the ureters in the prevesical area, before irradiation, though desirable, would be a very difficult matter. Further advances in surgery may perhaps solve this problem for us. At present it would seem that surgeons should be consulted as soon as serious obstruction has been found to exist, to the end that the affected kidney and the patient's life may be saved. Perhaps the earliest and safest procedure at present is to sever the totally obstructed ureter at the point of obstruction in the pelvis and bring the severed end out of the abdominal wall for permanent external drainage of the urine. If such a surgical procedure is done early enough, it may prove life-saving.



Film 6. Lateral view showing sharp angulation of ureter.

SUMMARY AND CONCLUSIONS

1. Ureteral obstruction must be assumed as a definite hazard in the treatment of cervical cancer by radium and x-rays. Literature on this subject and the personal observations of the writer would indicate that this is a frequent aftermath of heavy irradiation of the cervix.

2. It is believed that this hazard is not always realized by the radiologist and that adequate steps are not taken to prevent its occurrence, with subsequent death of the patient. Certainly we must doubt that this complication is generally known to exist by the many physicians who rent radium for an occasional case and know little of the technical factors involved or the possible complications from its use. Even those who make radiology a specialty may at times forget this danger.

3. Ureteral damage is believed to be a far more serious and frequent complication of irradiation therapy of cervical cancer than bowel or bladder damage. Yet, in recent years, one has heard far more discussion of bowel damage and possible measures for combating it than of damage to the kidney and ureters.

4. It is hoped that this paper will stimulate further interest in the study of this complication. Improvement of our statistics of cervical cancer cures may be shown to result from a greater interest in preservation of ureteral patency and post-irradiation management.

5. Conclusion of the irradiation program should not conclude the interest of the radiologist in the case. Proper in-

structions to the patient, preferably on a written card or folder, have a place in the after-care. Patients cannot be expected to co-operate when the importance and reasons for co-operation have not been thoroughly explained.

6. Each patient presents the possibility of preventable lethal complications. If these are watched for and proper steps are taken in time, many lives will be saved. This all adds up to lower mortality statistics.

Jefferson City, Mo.

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The Development of Centralised Radon Services in Australia[1]

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SINCE THE gamma rays used therapeutically are emitted by Radium B and Radium C, either of the parent elements radium or radon can be used as a source of gamma radiation. With the use of each, certain advantages and disadvantages are associated, but in general any national radium scheme (1, 2) has provided for both methods of treatment. In the majority of cases, the use of radon has been restricted to the type of applicator known as a "seed," intended either for permanent or temporary insertion in the tissues and usually characterised by short length and low filtration. Clinical experience with this form of applicator has not been particularly satisfactory, and a decreasing use of radon has been reported from several countries (3). It has been stated that the circumstances under which radon has been used have frequently been unsatisfactory, and the Radium Commission of Great Britain stipulated in 1939 that radon produced from national radium should be employed only in approved centres or under circumstances as carefully controlled as those in which national radium was used. From the records at its disposal, the Commission feared that radon prepared from other than national radium was frequently used by unqualified persons, who were without the auxiliary services by which the use of radon can be made safe, and who did not keep the accurate records which are required for all radiotherapy performed under the auspices of the Commission. It appears possible, therefore, that the unsatisfactory results in the use of radon have been due rather to the method of use than to any inherent disadvantages in radon itself.

The Australian National Radium Scheme was inaugurated in 1928, when, on the recommendation of the Director-General of Health, the Commonwealth Government decided to purchase 10 grams of radium and to distribute this among Australian hospitals. At the inception, provision was made for radon to be made available, and its use has increased steadily throughout the continent. Additional quantities of soluble radium have become available until there are at present 3.66 gm. of radium used in radon production. It is believed that this increased use has resulted primarily from the manner in which the radon is mounted in containers, and that as a result it has been possible to develop centralised radon services which have important advantages. The purpose of this report is to trace the developments in the use of radon in Australia and to describe the manner in which the present centralised services are operated.

Radon centres were established in Melbourne and in Sydney in 1929, in Adelaide in 1930, in Perth in 1933, and in Brisbane in 1938. The Melbourne centre was situated at the original Commonwealth Radium Laboratory, established at the University of Melbourne by arrangement between the Commonwealth Department of Health and the University. The Department equipped, staffed, and maintained the Laboratory. In each of the other centres the radon laboratory was established at the local university by arrangement between the university and the local anti-cancer authorities, the Commonwealth making available the necessary soluble radium. Initially methods of purifying and mounting radon were determined individually by the authorities at each centre, and experience was thus gained of a variety of techniques. A considerable amount of investigation into various methods of purifying and mounting radon was carried out at the Commonwealth Labora-

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TABLE I: TOTAL MILLICURIES USED FOR TREATMENT PURPOSES IN AUSTRALIAN RADON CENTRES

Year	Melbourne	Sydney	Adelaide	Perth	Brisbane	Total
1929	3,720	...	...	...	...	3,720
1930	11,919	...	...	...	...	11,919
1931	17,021	405	2,190	...	...	19,616
1932	14,008	1,096	2,335	...	...	17,439
1933	17,583	773	1,718	...	...	20,074
1934	21,960	...	2,013	...	...	23,973
1935	26,155	2,839	5,926	979	...	35,899
1936	28,055	6,476	5,988	782	...	41,301
1937	29,897	6,300	4,624	875	...	41,696
1938	29,695	7,857	...	1,922	6,966	46,440
1939	27,131	8,374	960	1,019	10,131	47,615
1940	27,700	7,981	6,897	563	7,912	51,053
1941	29,537	6,297	6,259	1,173	5,648	48,914
1942	39,751	8,413	4,134	864	4,359	57,521
1943*	20,632	4,987	2,061	358	3,917	31,955

* Six months only.

tory, and the various types of radon containers in use today were successively developed with the co-operation of practising radiotherapists. In 1935, efforts were made to have standardised procedures adopted throughout Australia (4) and, as a result, a definite impetus was given to the use of radon in all centres; this is illustrated by Table I, which gives the number of millicuries used annually for treatment purposes in the various centres.

Initially, the usual chemical methods of purifying radon were used, whereby oxygen and hydrogen were removed by sparking and passage over heated copper and copper oxide, and water and carbon dioxide were absorbed by phosphorus pentoxide and potassium hydroxide, respectively. These methods were slow, required the frequent replacement of chemicals which were contaminated with active deposit, and did not give a high degree of purity; radiation exposure of the personnel during purification was also considerable. In 1936, after extensive investigations in this Laboratory, a new equipment (5) depending upon physical rather than upon chemical methods was adopted, and similar equipment is now in use in Sydney, Brisbane, and Adelaide, while the Perth equipment includes many of its features. With this method, water and other vapors are removed by passing the mixed gases from the radium flask through a tube cooled with solid carbon dioxide; the hydrogen, oxygen, and helium are pumped off after the radon and carbon dioxide have been condensed with liquid oxygen, and after evaporation the carbon dioxide is finally absorbed by heated potassium hydroxide. The time of purification has been reduced to one-half, the exposure of the operator to one-fifth, while the final purity of the radon is considerably increased. In a routine purification, a purity can be obtained such that from 60 to 100 mc. can be inserted in a volume of 1 cubic millimeter at less than atmospheric pressure and at room temperature; this corresponds to capillary filled with radon with a linear strength of up to 15 mc./cm. If the radon is condensed a second time, however, and the permanent gases and carbon dioxide are removed after each condensation, concentrations of up to 200 mc./cubic millimeter can be obtained.

At the beginning, the purified radon was sealed in thin-walled glass capillary, which was then subdivided into appropriate lengths, measured, and mounted in short platinum needles. This method had certain serious disadvantages:

(1) The glass capillary was fragile and easily broken in the laboratory, in the hospital, and in transit, leading to a definite risk to the personnel from inhaled radon, and to inadequate treatment of the patient.

(2) The subdivision of the glass capillary and the subsequent measurement and classification into strengths was a laborious process.

(3) It was not always possible to obtain the required radon content in the glass seed, and a considerable proportion of the radon was not of a usable strength.

(4) The needles made in this way always represented a compromise between filtration and external diameter.

(5) Only a restricted number of needle lengths could be made available.

For these reasons, the glass capillary method was replaced early in 1930 by the gold-tubing technique developed by Failla (6). In this technique, the purified radon is led into a capillary tube of pure gold with a very fine bore (0.16 mm.); pure gold tubing is used, because it can be readily subdivided with gas-tight seals by the use of a special form of pliers which produce an autogenous weld as they cut. The gold capillary had an external diameter of 0.82 mm., with an equivalent screenage of 0.3 mm. Pt. The subdivided sections could be inserted directly into the tissue as permanent implants. Although these were a great improvement over the glass-tube type of permanent implants (7, 8), clinical experience showed that, in the majority of cases, a filtration of more than 0.3 mm. Pt equivalent was desirable. Accordingly, in 1934, gold capillary of external diameter 1.25 mm., giving a screenage of 0.5 mm. Pt equivalent, was used for the construction of permanent implants. These contain up to 1.1 mc. per implant and are issued with lengths ranging from 3 to 5 mm. according to the strength of the radon-filled capillary available. Permanent implants are used in many sites where the use of temporarily inserted needles is contraindicated (9). Less than 4 per cent of the radon used in Australia in 1942, however, was in the form of implants, so that the popularity of radon is not dependent upon those cases in which it presents the only possible therapeutic method.

The 0.3 mm. Pt equivalent radon-filled capillary could also be placed within metal sheaths to form Muir tubes or short needles. Initially, sheaths of nickel from 5 to 10 mm. long were used; these were constructed from nickel tubing, one end being first burnished over to hold the knot of a linen thread, while the other, after insertion of the capillary, was burnished over to hold it in place. Later, needles of varying length up to 8 cm. were issued, the sheath being burnished over to form a suitable point (8). The total screenage of the capillary and casing could be either 0.4 or 0.5 mm. Pt equivalent, the lesser filtration being chosen by those radiotherapists who preferred needles of smaller external diameter. In general, all needles were used with a strength of 2 mc./cm.; the 0.3-mm. gold permanent implants contained about 1.5 mc. in a length of from 6 to 8 mm., these values being selected as a result of clinical experience (10).

At the Third Australian Cancer Conference in 1932, the question of adequate screenage of radium containers received careful consideration, and a committee appointed to survey the position reported (11) that for the effective treatment of certain types of cancer, and especially for the treatment of lesions in certain sites, increased screenages were desirable. The committee was guided to a considerable extent by the experimental investigations of Wright, who implanted radon needles with filtrations of 0.5 and 0.8 mm. Pt equivalent, respectively, in corresponding situations on opposite sides of animals, the radon contents of the needles being adjusted to give equal emergent gamma ray intensities. Examination showed that with the needles of lower filtration, the immediate periacicular zones of destruction were much wider, while late necroses tended to occur in the sites treated (12). For gynæcological work, the committee recommended that 5-mg. tubes should have a filtration of 1.0 mm. Pt equivalent, and 10-mg. tubes and higher should have 2.0 mm. Pt equivalent, while for cases where needles were placed in close proximity to bone, cartilage, or important nerve trunks, or in the bowel, the filtration should be 0.8 mm. Pt equivalent. In accordance with these recommendations, a considerable proportion of the Commonwealth

radium was increased in screenage, and radon needles with a filtration of 0.8 mm. Pt equivalent were developed in the Commonwealth Laboratory and issued towards the end of 1932. To obtain the maximum screenage with a minimum thickness, a metal of high density must be used, and pure gold has been found the most suitable. The needle sheaths were constructed of tubing with a bore just large enough to take the radon-filled sections of capillary and with an external diameter of 1.93 mm. These needles could be obtained in lengths up to 10 cm., strengths of 1.5, 1.8, and 2.0 mc. being most frequently used because in this way established radium techniques could be duplicated.

As a result of the adoption by individual radiotherapists of techniques by which needles of a variety of strengths are used to obtain a practically uniform irradiation field and the desired dosage distribution, such as those developed by Paterson and Parker in Manchester (13), radon needles were issued with any strength required by the radiotherapist. By 1939, the Paterson and Parker technique had been introduced into all the principal Australian hospitals, and large-scale graphs, prepared by this Laboratory based on those developed in Manchester and modified where necessary, were in general use.

The availability of radon needles of any required strength is an important advantage in applying rationalised irradiation techniques. In these techniques, the radiotherapist determines the dimensions of tissue to be treated, the average dose required in roentgens, and the preferred time of treatment, and the required dosage in milligram-hours is read from the graphs. If radium is to be used, the available range of strengths and lengths of radium needles is then considered, and frequently the volume treated and the duration of treatment have to be adjusted to conform with the radium needles chosen. With radon needles, however, the required lengths and strengths are calculated to satisfy the chosen conditions. Radon needles are available in half-centimeter sizes from 1 to 5 cm., and in centimeter sizes from 5 to 10 cm., while strengths ranging from 0.2 to 1.0 mc./cm. in steps of 0.05 mc./cm., from 1 to 2.0 mc./cm. in steps of 0.1 mc./cm., and from 2 to 5 cm. in steps of 0.25 mc./cm. are available. Still other strengths can be obtained by special arrangement. Strengths greater than 1.5 mc./cm. are generally used in the construction of superficial applicators, while the very high strengths are used only for large treatment distances or in sites where the inability of the patient to tolerate the applicator reduces the duration of the treatment considerably below the customary seven days.

The extent to which the range of lengths and strengths of radon needles makes possible a ready arrangement of sources to provide homogeneous irradiation of irregular blocks of tissue can best be illustrated by the particular example given in Appendix I. It is evident that any hospital would require a very large reserve of radium needles of a wide variety of lengths and strengths to treat within the required dosage limits such a volume of tissue.

It is not, of course possible to fill the capillary with radon to exactly the required strength at the time of insertion in the patient. The needles are constructed by selecting a capillary with a strength slightly greater than that required for the needle (14); if the active length of the needle is a cm., and the required content is obtained in b cm. of capillary, then the needle is filled with $n + 1$ pieces of capillary, giving a total length of b cm., separated one from the other by n packing pieces of copper wire having a total length of $a - b$ cm. Provided that the lengths of packing are small compared with the active sections of capillary, it can be shown, both theoretically and experimentally, that the composite needle approximates closely a uniform linear source.

Where needles were to be used for constructing superficial applicators (used with a skin distance of 0.5 or 1.0 cm.) the capillary was sometimes placed, for reasons of

economy, in silver casing with the same dimensions as the gold casing, but giving a total filtration of 0.5 mm. Pt equivalent. Of recent years, however, gold casing of 0.8 mm. Pt equivalent has been used for both superficial and interstitial applicators.

For lesions of the eye, needles of up to 3 cm. in length are available with an external diameter of 1.74 mm. and an equivalent screenage of 0.7 mm. Pt. When the point is being burnished over, the knot of a second thread can be included in this end, giving a needle threaded at both ends to facilitate accurate positioning. These needles were designed for subconjunctival implantation, but may also be used in other sites where a needle of small diameter is required.

During 1942, approximately 70 per cent of the radon used in Australia was mounted in needle form, and it can be claimed that the demand for this type of container is due to the following advantages:

(1) Radon needles are constructed in the particular lengths and strengths necessary to deliver the required dosage for the particular lesion for which they are ordered.

(2) Radon can be enclosed in a much smaller volume than an equivalent gamma ray source of radium. Gold radon needles with a screenage of 0.8 mm. Pt equivalent have an external diameter of 1.93 mm. compared with 2.30 mm. for a platinum radium needle of the same screenage, thus facilitating their insertion into the tissues.

(3) Radon needles (containing gold capillary) can be bent as desired to suit the anatomical site.

(4) Radon needles can be obtained in much greater lengths than radium needles.

(5) The active length of a radon needle approaches the total length much more closely than in the case of a radium needle; for longer needles, the difference is 0.5 cm., for short needles 0.3 cm. This is of considerable advantage when "crossing ends" of an implantation.

(6) Experimental types of radon needles, or needles designed for special circumstances (*e.g.*, with inactive lengths where desired), can readily be constructed to suit the particular needs of individual cases.

(7) Since the needle cases are fitted with threads before filling, the radiation exposure of the hospital staff is decreased.

For gynæcological work, the early applicators were chromium-plated brass tubes with an active length of 2 cm., a filtration of 1.0 mm. Pt equivalent, and an external diameter of 6.37 mm. These tubes contained one or more pieces of radon-filled capillary to give a linear strength as desired up to 20 mc./cm. Later, a special type of applicator for the treatment of carcinoma of the cervix uteri was developed by Cuscaden and Oddie (15), consisting of a square rigid pessary of vulcanite containing four tubes placed around the cervix (one of which is screened dorsally by 8 mm. of lead to protect the rectum) and an intra-uterine tube of the required length with the radon distributed in three sections to obtain the required shape of isodose curves. To obtain satisfactory screenage with a minimum diameter, these tubes are made of pure gold, giving a total screenage of 1.8 mm. Pt equivalent with an external diameter of 4.75 mm. Where the higher filtration is required, gold tubes can also be used as an alternative to the brass tubes mentioned above.

For the treatment of carcinoma of the corpus uteri, a special intra-uterine tube was designed (16) with radon distributed in sections to give isodose curves enveloping the fundus.

For the treatment of non-malignant conditions of the uterus, a special intra-uterine tube was constructed in 1939 to the design of Dr. W. P. Holman and Mr. M. W. Ingram, B.Sc., of the Launceston Hospital. This tube contains radon distributed in two sections, the strengths of the sections being arranged to deliver 3,000 r in five days to the whole of the mucosa.

When radon is used in gynæcological applicators, it is possible to provide sources of any required strength in any position

in the applicator. It is therefore possible to adjust the distributed strengths to furnish adequate dosage to a uterus of any given dimensions much more easily than with radium tubes of fixed content, in which the increments of content are relatively large.

During 1942, the radon issued in the form of uterine applicators represented approximately 18 per cent of that used for treatment in Australia.

Applicators of various types for the treatment of nasal lesions have been prepared, when required, to suit the particular problem involved. These applicators take the form of rigid or flexible metal tubes filled with pieces of capillary.

Following the arrival of the U. S. Army in Australia, Major J. E. Bordley, formerly of Johns Hopkins University, wished to use the method developed there of destroying lymphoid tissue in the eustachian tubes by the use of radon. For this purpose, a special form of applicator was constructed. A brass rod 2.82 mm. in diameter was drilled with a hold of diameter 0.82 mm. to a depth of 2 cm., and a piece of gold capillary inserted for 0.5 cm. and sealed with gold solder. The capillary served to connect the applicator to the radon purification apparatus and provided the seal after filling; the source was then screwed into a handle of the same diameter and of convenient length. Sources of 400 mc. with a filtration of 1 mm. of brass could easily be placed in applicators of these dimensions; in general, the content ranges from 250 to 400 mc., depending on the amount of radon available. Thirteen of these applicators have been supplied at monthly intervals.

Since all radon containers are prepared in the issuing laboratory for the individual case, provision is required for the accurate measurement of the radon content. This involves the comparison of the intensities of the gamma rays emitted by the radon source and a radium source of known content, due allowance being made for differences in screenage, size, and shape of the two sources. The Commonwealth Laboratory possesses an international substandard radium source and the corrections necessary in the measurement of the various types of radium and radon containers, as well as various measuring equipments, have been investigated (17). Each radon centre possesses a set of substandard radium tubes calibrated in terms of the Australian standard, and these are used in the measurement of radon content.

When radon is first introduced into the capillary, no Radium B and Radium C are present, and there is no gamma ray activity. As these two products are successively formed and decay, the gamma ray intensity increases until a maximum is attained in approximately five hours, when equilibrium is reached; thereafter the decay characteristic of radon, with a half-value period of 3.825 days, is followed. In practice, the capillary is measured approximately one hour after filling, and the final content determined from a knowledge of the growth curve and the time elapsing between the filling of the capillary and the measurement. The radon content in mc./cm. of lengths of capillary approximately 10 cm. long is calculated, and the capillary is subdivided in sections to give the content required in the different containers at the intended time of commencement of treatment. These sections are then inserted into the needle casing or other container, the whole operation frequently being completed before maximum intensity has been reached. The handling of the containers during the relatively inactive stage is an important factor in reducing the radiation exposure of members of the staff.

In general, it is necessary to fill different sections of the capillary at any one purification with a range of strengths determined by the containers on order. These sections are then subdivided into lengths of approximately 10 cm. The accuracy with which any needle can be filled with the required content at the first intent depends upon the uniformity of linear strength within the various sections. If a number of 10-cm. lengths are cut from a

section filled with a given pressure of radon, the strengths of the individual lengths usually lie within 5 per cent of the mean value, and when these 10-cm. lengths are further subdivided the variation is usually less than one-half this amount. A greater unevenness of distribution frequently results if the radon is not purified sufficiently before being led into the capillary. The subdivision of the measured capillary to provide pieces of the required content for constructing needles and tubes is carried out with pliers mounted on a fixed fulcrum, the length of the pieces cut being determined by a micrometer adjustment. These pliers have been designed to reduce the flattening of the capillary and the extent of the chisel ends to a minimum. Possibly because of this, there is no marked concentration of the radon along the capillary such as has been reported by some workers. Since, further, the pieces for a number of needles of the same strength are cut together and each needle is filled with pieces selected at random, the effect of small variations in the linear strength of the capillary tends to be eliminated.

The extent to which the active content of needles can be obtained with the desired value merely as the result of preliminary measurement of 10-cm. lengths and subdivision into the required portions can best be illustrated by the analysis of over a thousand needles of varying content from 0.5 to 10 mc. given in Table II.

TABLE II: COMPARATIVE ANALYSIS OF DEVIATIONS OF ACTUAL FROM NOMINAL CONTENTS FOR RADON AND RADIUM NEEDLES

Deviation from Nominal Content	Radon Needles, Per Cent	Radium Needles, Per Cent
Within 2.5 per cent	46	22
Within 5.0 per cent	78	47
Within 7.5 per cent	92	91
Within 10.0 per cent	97	97

The active contents of any needles outside any required limit can be readjusted. Very few needles as issued are outside 6 per cent of the stated value, while in general the total content of the applicators required for any one lesion is within 2 per cent of the stated value.

A more complete understanding of the real meaning of the accuracies of the contents of radon needles as stated above can be gained by a comparative analysis of approximately 400 radium needles varying in content from 0.5 to 10 mg. measured as delivered by a reputable manufacturer and set forth in Table II. It will be seen that the variation of the actual from the nominal values was more marked with the radium than with the radon needles. Further, since a marked preponderance of the radium needles showed a value higher, rather than lower than the nominal value the total content of any selection of these radium needles for a particular lesion would be somewhat outside the limits possible with the radon needles, where the needles were found to be more uniformly distributed about a mean value

The success of any form of radon container depends upon the certainty with which gas-tight seals can be made during subdivision. This depends principally upon the design of the cutting pliers and the extent to which they are maintained in good order. In testing the performance of cutting pliers, it is convenient to solder a number (say ten) of pieces of gold capillary into the end of a metal cylinder attached to a compressed gas reservoir and fitted with a pressure gauge. In this way the efficiency of the pliers in making, say, 100 seals adequate to withstand, say, three atmospheres can be determined quickly. Pliers satisfying these conditions produce the much lower pressure radon-tight seals with certainty, provided the seals are made with a firm and continuous pressure.

Radiotherapists who use large numbers of radon needles annually very rarely have cause, from the observations of clinical results, to suspect radon leakages from needles. A needle which leaks before insertion in the patient will produce a lessened or negligible biological reaction, while leakage of radon into the tissues produces the violent necrosis associated with the action of alpha and beta rays. During the early years leakage from gold capil-

lary was occasionally detected, either in the radon laboratory or in the hospital, but this was found to be due either to minute air bubbles in the gold rod from which the capillary was drawn or to traces of grease introduced into the bore of the capillary during manufacture. Direct enquiry at the Royal Melbourne Hospital Radiotherapy Clinic (which has used an average of 11,000 mc. annually over the last eleven years) shows that the clinicians have absolute confidence that the radon sources as ordered will deliver the dosage calculated (18). Only on the rarest occasions is the expected degree of biological reaction not obtained, and it is considered that such effects are more often due to faults in planning or in implantation technique than to defects in the radon apparatus.

Doubts have been expressed at times as to the ability of the gold seals to tolerate the increased temperature of a steriliser. Experience here, however, has confirmed the statement (19) that sterilisation by boiling is a perfectly safe procedure. In fact, when for a particular investigation it was desired to extract the radon from a filled capillary, it was found impossible to cause the radon to leak out until a temperature of approximately 900° C. had been reached.

In filling the active sections into a needle, however, it is possible, by using excessive force, to damage the seal mechanically by ramming the sections together. With a little training, and specially designed filling devices (14), filling can be accomplished without risk of damage and subsequent leakage.

The Commonwealth Laboratory is responsible for the construction of the gold tubing and special types of applicator used by all centres. Approximately 100 ft. of 0.3-mm. capillary, 12 ft. of 0.5-mm. capillary, and 7 ft. of casing are required monthly. All used radon needles and tubes are returned to the centres after removal from the patient, stored until inactive, and then reopened. The casing is used again to make a smaller needle and the capillary and scrap are purified to special specifications and reconstructed into tubing. Apart from the capital in outlay for gold (on which there is no depreciation) the expense involved is that for reconstruction of the tubing and refining of the scrap, approximately £45 per month for all Australian requirements.

The development of radon containers of the types set out above has thus provided an alternative agent to radium in practically all cases. The Commonwealth radium is distributed only among those Australian hospitals which have on their staffs radiotherapists experienced in its use and which provide the necessary auxiliary clinical and clerical services. The majority of these hospitals are concentrated in the State capitals. Issues of radon are similarly restricted to hospitals which have radiotherapists experienced in its use, and in most cases radon is used in hospitals which have also a supply of radium. The choice of radon as a therapeutic agent is therefore made by the radiotherapist, taking into consideration the suitability of the available radium for the particular lesion. Radon is, however, frequently preferred when the patient can be treated as an out-patient, since the low intrinsic value of radon permits of this being done, whereas hospitalisation is essential when radium is used.

When radon is available after the requirements of hospitals have been satisfied, it may be issued to radiotherapists who are experienced in its use, for the treatment of private patients. Radon issued to public hospitals is made available free of charge; that issued to private radiotherapists is charged for on a sliding scale, which commences at a minimum of £1.1.0 for 15 mc. and rises in increments of 5 mc. to £3.1.0 for 50 mc., £4.15.0 for 100 mc., and £7.5.0 for 200 mc.

Since the various Australian radon centres have developed along lines suggested by local requirements, the general conditions of radon mounting and issue vary somewhat from centre to centre. A brief survey of the characteristic features

of each centre will indicate the various possibilities of radon services.

The Australian scheme for radiological-physical services provides for a central laboratory serving as the standardising and advising centre, together with local physical services situated in each State. The radon centres are associated with these local services, so that the preparation of radon is in the hands of physicists and technicians who specialise on a whole time basis in radiological physics, and who are in constant touch with the radiotherapy departments of the local hospitals. The physical problems arising in radon production and issue, therefore, are not treated in a limited sense, but as a portion of a general radiotherapeutic service. The close association of the physical service with the practising radiotherapist is essential in developing that spirit of co-operation without which little progress would have been possible.

THE COMMONWEALTH X-RAY AND RADIUM LABORATORY

The Commonwealth Laboratory, housed since 1938 at the University of Melbourne in a specially designed building erected with funds provided by the Anti-Cancer Council of Victoria, takes care of the radon requirements of Victoria, Tasmania, and southern New South Wales. The laboratory is equipped, staffed, and maintained by the Commonwealth Department of Health, the Anti-Cancer Council of Victoria making an annual grant in return for the radon and local physical services provided by the laboratory in that State.

The area served with radon from the Commonwealth Laboratory contains a population of 2,235,000. Other radiotherapeutic facilities distributed throughout the area include 2.4 gm. of radium mounted in the form of plates, needles, and tubes, and 10 deep-therapy and 2 contact-therapy x-ray units, together with more than 20 units used for superficial therapy.

Radon is prepared from 1,845 mg. of radium in solution, two identical purification equipments being available. Purifications are carried out on the average daily from Monday to Friday, issues being made when required on these days and when necessary on Saturday. Since in all hospitals the honorary radiotherapist system is in force, radon is used in any particular hospital only on the radiotherapist's operating day (or days). These have been adjusted between the hospitals to equalise as far as possible the daily radon requirements. Issues to private practitioners are made on any day on which the radon is available.

During 1942, issues were made regularly to eight hospitals in Melbourne and ten in rural districts, as well as to eight private radiologists in Melbourne and six in the country. Total hospital issues amounted to 31,931 mc., while those to private radiologists totalled 7,820 mc., 1,108 patients being treated in all. The radon was distributed among the various types of containers as follows: implants, 2 per cent; needles, 75 per cent; tubes (uterine and nasal), 23 per cent. Of the radon issued in needle form for interstitial use, 13 per cent was at a strength of less than 0.75 mc./cm., 37 per cent was between 0.75 and 1.0 mc./cm., and 50 per cent between 1.1 and 1.5 mc./cm. The needles were distributed among the various lengths as follows: less than 4 cm., 58 per cent; between 4 and 7 cm., 32 per cent; over 7 cm., 10 per cent (20). All containers remain the property of the Laboratory and are charged for if not returned. Radon users exercise considerable care of these containers, as of the 6,436 issued last year, only 16 were not returned.

Issues to centres outside Melbourne last year amounted to 5,746 mc. Country centres using radon are situated 45, 100, 110, 145, 204, 260, 325, 380 and 580 miles, respectively, from Melbourne. The last-mentioned centre, a U. S. Army Base Hospital, received 1,023 mc. Radon is transported in specially designed lead boxes by air or fast passenger train, operations at the centre being arranged to take place soon after arrival.

For the period June 1940 to September 1942, the Sydney radon centre was out of commission due to the reconstruction of the local physical service and delays occurring in preparing new accommodation. During this time radon was made available from the Commonwealth Laboratory, issues being forwarded twice weekly, leaving Melbourne by train at 6 P.M. and arriving in Sydney, 575 miles distant, at 9 A.M. the following day. Issues made in this way during 1942 amounted to 4,462 mc. for use in Sydney by six hospitals and seven private radiologists. The total issues made to centres outside Melbourne, therefore, amounted to 10,208 mc., being 26 per cent of the total treatment issues.

The operation of a centralised radon service of this type requires very careful organisation. Orders for radon are required three days before issue; in the case of country orders, optional delivery days are often stated. A special telegraphic code has been developed for the use of country centres, whereby quite complicated orders for needles of varying lengths and strengths, together with full information regarding type of threads required, time of insertion, etc., are transmitted at small expense. In general, a country centre is just as favourably placed as one in Melbourne in obtaining prompt deliveries of orders given.

The figures given above refer always to the number of millicuries at the time of insertion. Because of the decay occurring between the time of preparation and insertion, however, an appreciably larger amount of radon is required to fill the applicators. There is also a wastage of radon when the orders received are less than the radon available on any one day, or when radon available on one day has to be used to fill a large order on the succeeding day. Naturally, the weekly requirements from the hospitals vary considerably. During 1942, the average weekly issue for all purposes was 910 mc.; the actual issue was under 600 mc. for five weeks, between 600 and 800 for twelve weeks, between 800 and 1,000 for sixteen weeks, between 1,000 and 1,200 for fourteen weeks, between 1,200 and 1,400 for four weeks, and one week it exceeded 1,500 mc. The satisfaction of such fluctuating demands requires the most careful planning of the available supply. When it is known that a portion of the radon purified on one day will not be required until two or three days later, then it is filled into a section of the capillary at such a strength that after decay it will still be in the usable range. A supply of filled capillary of various strengths is practically always on hand, and from this urgent orders can usually be filled at a few hours' notice.

SYDNEY RADON CENTRE

The Sydney Centre was originally established in 1929 in association with the Physics Department of the University of Sydney and was operated by the Cancer Research Committee of the University. In 1940, the local physical services were reconstituted under the Hospitals Commission of New South Wales. The service is now located at Royal Prince Alfred Hospital with Mr. B. W. Scott, B.Sc., in charge. The area served by this centre has a population of 2,775,000. Other radiotherapeutic facilities available include 3.9 gm. of radium in plates, needles, and tubes, 8 deep-therapy x-ray units and one contact-therapy x-ray unit, together with a number of units for superficial therapy. Radon from 500 mg. of radium in solution is issued to eight hospitals and five private radiotherapists in Sydney. In general, radon is purified twice weekly and arrangements have been made as far as possible for the application of the radon to patients on two days weekly. During the year 1942, 6,552 mc. were used by hospitals, and 1,861 mc. by private radiotherapists.

Considerably greater use is made of permanent implants in Sydney than in other centres, so that an appreciable portion of the purified radon is filled into 0.5 mm. Pt equivalent gold capillary. From this the required implants are taken, and the remainder is then used without ad-

ditional mounting for constructing superficial applicators. For the needles and tubes required, radon is filled into 0.3 mm. Pt equivalent gold capillary. During 1942, 32 per cent of the radon issued was contained in 2,509 sections of 0.5 mm. capillary (used in approximately equal proportions for implants and superficial applicators), 60 per cent was in the form of gold needles, and 8 per cent in the form of tubes. In all, 609 patients were treated with radon from the Sydney Centre during the year.

ADELAIDE RADON CENTRE

The Adelaide Centre is operated by the Adelaide University Cancer Campaign Committee, with Mr. B. W. Worthley, B.A., B.Sc., in charge. The area served has a population of 600,000. Other radiotherapeutic facilities include 0.7 gm. of radium mounted in plates, needles and tubes, 4 deep-therapy x-ray units, and one contact therapy x-ray unit. Radon from 445 mg. of radium in solution is issued to one hospital and one private practitioner in Adelaide, purifications being made in general twice weekly. During 1942, 3,987 mc. were issued to the hospital, and 147 mc. for use in private practice. Less than 1 per cent of the radon used was in the form of permanent implants, and these were of 0.3 mm. Pt equivalent. All radon, therefore, is filled into 0.3 mm. capillary; 99 per cent of the radon issued was in the form of needles, 53 per cent being for interstitial use and 46 per cent being used in the construction of superficial applicators. A total of 243 patients were treated with radon during the year.

PERTH RADON CENTRE

The Perth Centre is operated by Professor A. D. Ross, and the staff of the Physics Department of the University under an arrangement with the Perth Hospital Board. The area has a population of 470,000. Other radiotherapeutic facilities available include 0.7 gm. of radium in plates, needles, and tubes, and 5 deep-therapy x-ray units, as well as some units used for superficial therapy. The use of radon in Perth is somewhat limited, only 292 mc. being issued to the hospital and 572 mc. to private radiotherapists during 1942 from the 375 mg. of radium in solution. All radon was mounted in needle form. A total of 43 patients were treated with radon during the year.

BRISBANE RADON CENTRE

The Brisbane Centre serves a population of 1,020,000. Other radiotherapeutic facilities include 1.7 gm. of radium in the form of plates, needles, and tubes, 5 deep-therapy, 2 contact-therapy, and a number of superficial therapy x-ray equipments.

The centre is operated by the Queensland Cancer Trust, the Brisbane Hospital Board, and the University in conjunction, Mr. D. F. Robertson, B.Sc., being in charge (during the wartime absence of Dr. H. C. Webster) under the general direction of Professor Parnell. Radon from 469 mg. of radium in solution is issued to two hospitals and private practitioners in Brisbane. During 1942, 4,142 mc. were used by hospitals and 217 mc. by private radiotherapists. With the exception of 2 per cent issued in needle form, all the radon was filled into 0.5 mm. capillary, 11 per cent being used for permanent implants and the remainder for the construction of superficial applicators. Superficial applicators are used to a considerable extent in gamma ray therapy in Brisbane, and the use of the radon-filled capillary for these has been of considerable advantage both to the issuing centre and the radiotherapists, particularly as the physicist is available in the hospital to plan the required distribution as the applicator is being constructed. A total of 177 patients were treated with radon in Brisbane last year.

For eight months during 1942, issues of radon filled into 0.5 mm. capillary required in Sydney were supplied from Brisbane, 627 miles distant. A total of 1,336 mc. was issued, transportation being arranged by air freight or by train when the air service was dislocated.

ADVANTAGES OF CENTRALISED RADON SERVICES

It will be seen that a very extensive use is made in Australia of radon produced in centralised laboratories. Experience has shown that radon can be used as an alternative to radium and in some cases has very definite advantages, which have been enumerated above. A centralised radon service serving a number of hospitals has an additional advantage in that the radon available on any one day can be applied at those hospitals where gamma ray sources are needed, mounted with exactly the lengths and strengths required. Including the supplies forwarded to Sydney, the Commonwealth Laboratory in 1942 issued a total of 44,213 mc. to 24 hospitals and 21 private practitioners distributed in an area 800 miles long. In addition, a further 3,315 mc. were used for a variety of investigations. These figures correspond to a use for treatment of 23.9 mc./year/-mg. of radium in solution and 25.8 mc./year/mg. for all purposes. As radon is usually applied for a seven-day treatment period, the used gamma ray activity of the total radon issued amounts to 2,460 mg. hr./year/mg. in solution, so that the total radium in solution was used continuously for fourteen and a half weeks in the year. Because of the extension of the use of radon in Australia, it is not possible to determine locally what proportion of the radium holding of any hospital is used each week. Had the total quantity of radium in solution (1,845 mg.) been mounted in a full range of radium needles and tubes of varying lengths and strengths and distributed among even the 24 hospitals participating, it would have been necessary for each radium container to be used for a total of fourteen and a half weeks in the year to supply an equivalent gamma ray activity. With the distributed radium only a small proportion of the available radium containers in any one hospital would be suitable either in length or strength for use on a particular lesion offering for treatment (*e.g.*, the case referred to on p. 168); it would obviously be uneconomical to subdivide 1,845 mg. among 24 hospitals, but even if 4 hospitals were chosen it would not be expected that the exact specifications of radium needles and tubes would be available when required, to permit an average use of each for fourteen and a half weeks in the year. The restriction of gamma ray sources to 4 hospitals in this area, however, would require considerably more traveling of patients to these centres to obtain treatment than is necessary at present. A centralised radon service makes it possible, therefore, to supply gamma ray sources just where they are required and to cover economically the needs of an area.

One particular advantage of centralised radon services was evidenced when, owing to the international situation, wartime control of radium became necessary. In January 1942, the radium holdings of all hospitals in Australia were reduced to a minimum and the use of radium was limited to those types of container which, on notice of an air raid, could be removed from the patient in a few moments and placed within steel bomb-proof containers. This serious limitation of the use of radium has not resulted in any serious curtailment of radiotherapeutic facilities, since the use of radon was not affected, as this does not introduce the health hazards and economic considerations of dispersed radium. In this connection it is of interest to note that special arrangements were made to operate the radon services, if necessary, from bomb-proof sites, and that two of the services have been so operated since that date.

Experience has shown that the customarily enumerated disadvantages of radon are more academic than real. Although the radiation from a needle falls to half its initial intensity in 3.825 days (*i.e.*, it has fallen to 28 per cent in seven days), clinical experience has not shown any differences between reactions occurring with a constant radium source and a varying radon source. Indeed, if the cumulative tissue dose is considered, it can be shown that there is very little difference between the

values obtained over a seven-day period using radium and radon (21). When treatments longer than seven to ten days are used (which occurs in general only with superficial applicators), a new set of radon needles can be applied.

Dosage calculations require more care with a varying source than with a constant source. Many of the dosage calculations, however, are carried out for the radiotherapists by physicists attached to the radon centres or to hospitals, and it has been found that with study radiotherapists can understand and use with ease tables of radon exposure factors (14). In certain cases (*e.g.*, treatment with intra-œsophageal applicators) where the radon source is applied intermittently according to the tolerance of the patient, a nomograph (22) can be used by the radiotherapist to determine the actual dosage in roentgens received during each application, and by summation the total desired dose can be delivered.

A specially equipped radon laboratory with a carefully trained staff is also required in each centre. In Australia, it has been the custom to improve protection arrangements and utilize a permanent staff rather than use temporary employees in radon production. The physicists engaged in radon production are trained in all branches of radiological physics; consequently the radon centre and the local physical service for calibrating x-ray equipment and determining x-ray dosages are operated together. The same team of physicists and mechanics, therefore, associates with both x-ray and gamma ray therapists, with considerable mutual advantage.

In handling large quantities of radon, very complete protective measures must be adopted to reduce the radiation exposure of the personnel to safe limits. This can be achieved by close attention to the following essentials.

(1) Storage of all radon capillary not actually being handled in adequately protected lead drawers.

(2) Rapid manipulation of radon in all procedures where full lead protection is not possible. (For example, in measurement, the observer is at least 6 feet from the radon source which is being measured at appreciably less than its final strength.)

(3) Performance of all cutting of capillary and filling of needles, with the worker protected by from 4 to 6 inches of lead (14).

Regular surveys of the background radiation in various sections of the radon laboratory by an ionisation method (23) serve to indicate the areas of higher exposure and to direct attention to the necessity for additional protection. Dental films worn by the members of the staff over a working period can be developed and photometered to determine the actual exposure (24), and so direct attention to failure to utilize protective facilities provided. Finally, periodic blood examinations are required of all personnel.

Radon laboratories require thorough exhaust ventilation, while all manipulations of radon-filled capillary (such as cutting and filling into needles) should be carried out under evacuated hoods. Some form of ionisation measuring instrument should be set up permanently to indicate excessive ionisation; a projection electroscope with a very small natural leak will quickly show the presence of quite small radon concentrations. The fact that there has been no evidence of permanent change in the blood picture of radon workers in Australia indicates that satisfactory precautions against radiation can be taken. Where temporary changes in the blood picture have occurred, they have usually resulted from working in a radon-charged atmosphere arising during an accident, or when the cleaning of a radium solution has become necessary.

SUMMARY

Although on physical grounds radon can be used as an alternative to radium in treatment, in general a decrease in the use of radon has been observed in many countries. The use of radon has increased

steadily in Australia, however, and it is believed that this is due to the manner in which it is mounted for use.

All radon is filled into gold tubing. By the use of external sheaths, needles and tubes of a wide range of lengths and strengths can be constructed. Needles have proved to be of definite advantage in using rationalised systems of dosage distribution such as that of Paterson and Parker. The tubes permit the use of rationalised systems of uterine applicators with content selected to suit the dimensions of the uterus to be treated.

Altogether 57,500 mc. were issued for treatment purposes during 1942 from five radon-producing centres with a total of 3.66 gm. of radium in solution. Of this, less than 4 per cent was in the form of implants. Approximately 70 per cent was in the form of needles and 18 per cent in the form of tubes; the remainder consisted of radon-filled capillary used for constructing superficial applicators.

Radon issues are restricted to hospitals possessing radiotherapists experienced in its use. In the smaller capital cities the radon is issued to one or two hospitals and private practitioners, but the Melbourne and Sydney centres serve a number of hospitals, many of which are in remote rural districts. Such centralised radon services have been found to possess a number of important advantages, which are discussed in detail.

Acknowledgments: The developments in radon services described above have resulted from the associated activity of a number of workers, the publications of some of whom are referred to in the bibliography. The successive steps in the construction of radon needles and tubes were due principally to Mr. A. H. Turner, M.Sc., who was in charge of the Radium Laboratory from its establishment in 1929 until early in 1935. The development of the various types of needles was carried out in close association with Dr. L. J. Clendinnen, formerly Honorary Radiotherapist, and now Honorary Consulting Radiotherapist, to the Royal Melbourne Hospital, and with Dr. R. Kaye Scott, the present Honorary Radiotherapist to that Hospital, and of tubes with Dr. W. G. Cuscaden, Honorary Surgeon to the Women's Hospital, Melbourne. The sympathetic attitude of the Director-General of Health (Dr. J. H. L. Cumpston, C.M.G.) and the Senior Medical Officer of the Commonwealth Department of Health (Dr. M. J. Holmes) at all times has been a constant encouragement to those directing the developments in radon services.

It is a pleasure to acknowledge the assistance of Dr. R. Kaye Scott, who read through the draft of this report, making several valuable suggestions, and provided the typical treatment data set out in the Appendix.

APPENDIX

The following example, supplied by Dr. R. Kaye Scott and Miss Wellington, B.Sc., of the Radiotherapy Clinic of the Royal Melbourne Hospital, of the irradiation of a breast with radon needles illustrates the usefulness of needles covering a wide range of lengths and strengths particularly in treating large lesions. The routine treatment of inoperable carcinoma of the breast in that hospital consists of initial x-ray therapy to reduce the primary lesion and extensions. In suitable cases, radon needles are then implanted in the breast and lymph node areas of the axilla some six to eight weeks later.

In the case presented, one large plane of needles was selected to deliver a dose of 6,000 r in five and three-quarter days at a distance of 0.5 cm. in a block of tissue of area 230 sq. cm. on the anterior chest wall in the plane of the deep fascia.

A second rectangular plane of needles 8 cm. by 6 cm. placed in the subcutaneous tissues of the breast and at a distance of 2 cm. from the first plane was selected to augment the dosage in the tumour-bearing tissues to a maximum value of 8,000 r. A plane of needles 10 cm. by 7 cm. placed parallel to the medial axillary wall was required to deliver to the tissues bearing the axillary nodes a dose of 7,000 r at a distance of 0.5 cm. in five and three-quarter days.

With the aid of the modified Paterson and Parker graphs and with due allowance for the effect of cross-radiation between adjacent needles in the breast and in the axillary implants, the following needles were required.

Breast

Large Plane: Area 230 sq. cm., 6,000 r at a distance of 0.5 cm.
Two 10-cm., two 8-cm., two 6-cm. needles at 0.9 mc./cm.
Eleven 10-cm., one 9-cm., two 8-cm., two 6-cm. needles at 0.6 mc./cm.
Total: 22 needles, 131.4 mc.

Small Plane: Area 48 sq. cm., 4,300 r at a distance of 0.5 cm.
Two 8-cm., two 6-cm. needles at 0.8 mc./cm.
Five 6-cm. needles at 0.5 mc./cm.
Total: 9 needles, 37.4 mc.

Separation of planes, 2 cm.: maximum dose 8,000 r, minimum dose 6,500 r.

Axilla

Area 70 sq. cm., 7,000 r at a distance of 0.5 cm.
Two 10-cm., one 3-cm. needles at 1.5 mc./cm.
Four 10-cm. needles at 1.0 mc./cm.
Total: 7 needles, 74.5 mc.

The dosages at 0.5-cm. intervals in passing from the large plane to the small plane were calculated to be 7,600, 8,000, 6,500, 7,200, and 6,800 r, respectively.

It will be seen that a total of 38 needles containing 243 millicuries was used, the needles comprising five different lengths and six different strengths.

The areas given above are those over which it was intended to implant the needles. After implantation, the areas were re-measured and radiographed and the actual area over which the sources were distributed was determined. When the actual area differs appreciably from the intended area, the irradiation result is recalculated and the duration of treatment altered to give the intended dosage. While area implantations are usually fairly accurate, it is not always possible to predetermine with accuracy the separation between superficial and deep planes. The treatment time must therefore be chosen so that corrections for interplanar distances greater or smaller than was intended may easily be applied. Because of the decay occurring in the radon sources, the time of five and three-quarters days chosen in this case permits the necessary correction to be made without increasing the treatment time unduly. Because of the limited number of hospital beds available, and because of the fact that the honorary radiotherapist operates on inpatient cases only once a week, an extension of the treatment times beyond one week is liable to introduce serious administrative difficulties.

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The Evolution of an Improved Transvaginal Speculum[1]

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ANYONE WHO TRIES to add anything to the solution of the many problems met in the direct application of x-rays to cancer of the uterine cervix (1) must first acknowledge his indebtedness to E. A. Merritt. In 1920 (2) he treated cervical cancer, with rather spectacular results, using unfiltered x-rays through a glass speculum. The technical difficulties were tremendous. Because of the dangers of electrical shock and of accidental overexposure of the vulva, the tedium and discomfort of the treatments, and the impossibility of maintaining the lesion, the speculum, and the tube in fixed relationship, he had to abandon his efforts until high-powered, shock-proof apparatus became available. He then (3) began to apply x-rays to the cervix, and the tissues around it, through a speculum of the Ferguson type made of material transparent to the rays. He introduces the specula with the aid of obturators, and protects the vulva by a ring of opaque metal. The expanding beam of x-rays strikes the inner portion of the vagina and exposes a field surrounding the cervix which is much larger than can possibly be irradiated through opaque cylindrical specula. The dose to the vaginal wall increases as one nears the tube, according to the inverse-square law, but on the other hand, because of back-scatter, the intensity at the edge of a small field is about 30 per cent less than it is at the center. It is obvious, therefore, that the vaginal walls can be exposed for a distance from the cervix equivalent to one-fifth of the total anode-surface distance, without increasing the effective dose to the vaginal wall.

My own approach to the problem (4, 5) has been along different lines because of my obsession with the belief that a short

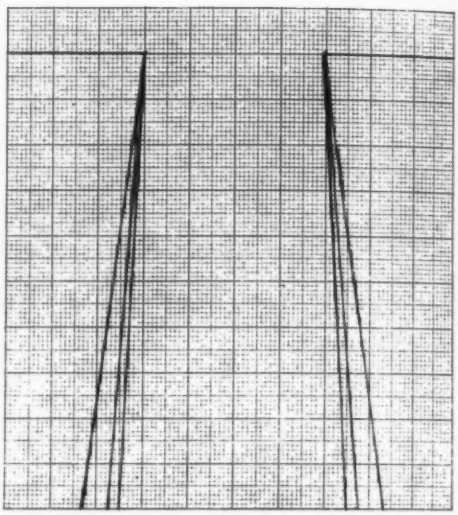


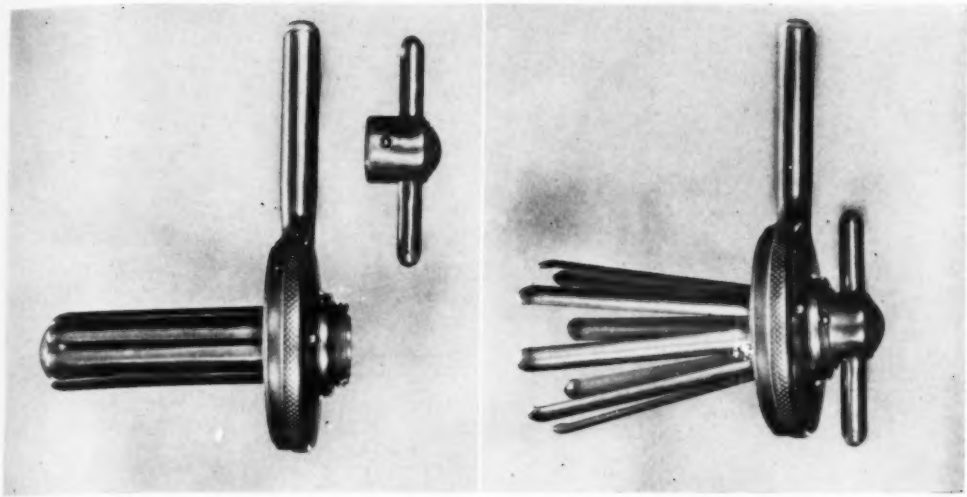
Fig. 1. Showing the rapid expansion of the beam with a short anode-surface distance. Through an aperture 4 cm. in diameter 10 cm. from the surface, the diameter of the field is 5 cm. when the anode-surface distance is 50 cm.; 5.5 cm. when the anode-surface distance is 35 cm.; and 6.6 cm. when the anode-surface distance is 25 cm.

(25 to 30 cm.) anode-surface distance should be used. There are three reasons for this belief:

1. As shown in Figure 1, the beam expands much more rapidly.
2. The time of the treatments, which at best are uncomfortable, is considerably shortened.
3. There is less danger of overexposing the rectum.

In order to use a short anode-surface distance, it is necessary to find some method of retracting a considerable portion of the vaginal wall. This I tried to do in 1937 with the eight-bladed expanding speculum shown in Figures 2 and 3. The blades of this instrument were 9 cm. long and the diameter of the opening at the introitus was 26 mm. The cone of rays exposed a field 4.5 cm. in diameter. Using

[1] Read by title at the Twenty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 1–2, 1943.



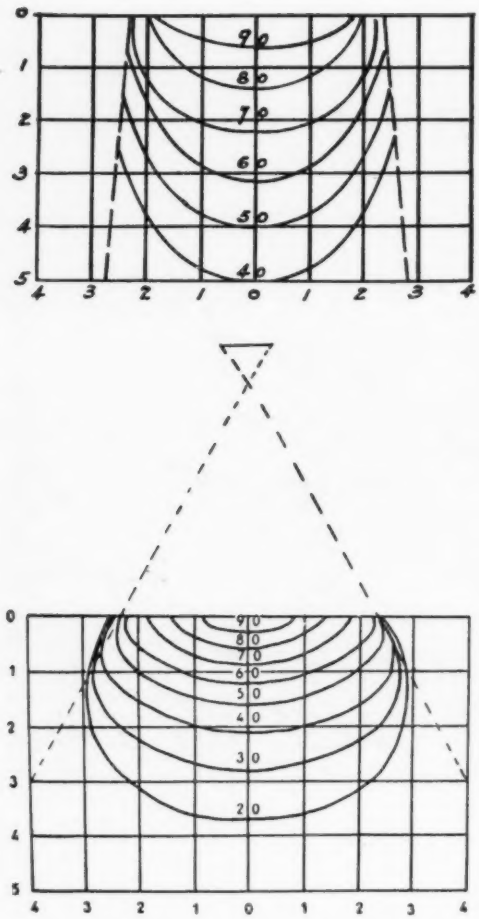
Figs. 2 and 3. Speculum (first model) with blades closed and obturator inserted and with blades expanded.

200 kv. and an effective filter of 0.75 mm. copper, and an anode-surface distance of 28 cm., an excellent distribution was obtained. It is shown graphically in Figure 4. It is interesting to compare this with the distribution obtained with the Chaoul technic and with radium. Mayneord (6), discussing rays from the Chaoul tube, says: "We may imitate fairly exactly the radium depth doses." This opinion seems to be supported by Arneson's exact study (7) of the distribution of the radiation from radium in colpostats in the lateral vaginal fornices, in combination with an intrauterine tandem. Assuming that Figure 5 represents the approximate distribution of radiation with good Chaoul technic, and also with good radium technic, a comparison with Figure 4 shows that about 28 per cent of the surface dose in one case, and 63 per cent in the other, reaches a depth of 3 cm. Incidentally, I have recently made a study of the distribution of x-rays produced at lower voltages. With 135 kv. and a filter of 0.25 mm. copper, the depth dose percentage at 3 cm. is still much higher than it is with the best radium technic.

Because the greatest expansion of the blades of the first model was at their inner ends, where the patients were least able to endure the discomfort of dilatation, it was found advisable to curve them and to substitute duralumin for steel. This instrument (Fig. 6) caused less discomfort but did not give such good visibility. It also considerably reduced the intensity of the dose at the edge of the field.

About two years ago I made an expanding blade instrument (Fig. 7) which, when closed, was approximately the shape of the Ferguson speculum. It consisted of eight blades with their inner ends joined together by a coil of duralumin wire, the blades being hinged at the junction of the aluminum and steel portions. When the instrument was covered with thin rubber tubing (cigarette drain), it was easily introduced and visibility was very good. When the blades were opened, the x-rays passed through their aluminum portion and exposed 3 to 4 cm. of the vaginal mucosa.

In the spring of 1942 several radiologists and physicists who had been using some modification of the transvaginal method met informally in Atlantic City. After J. C. Bouslog had emphasized the importance of adequate dosage to the lateral vaginal fornices, someone (probably A. N. Arneson) said that, since we want to expose as large a field as possible, and since it is more important to expose the lateral

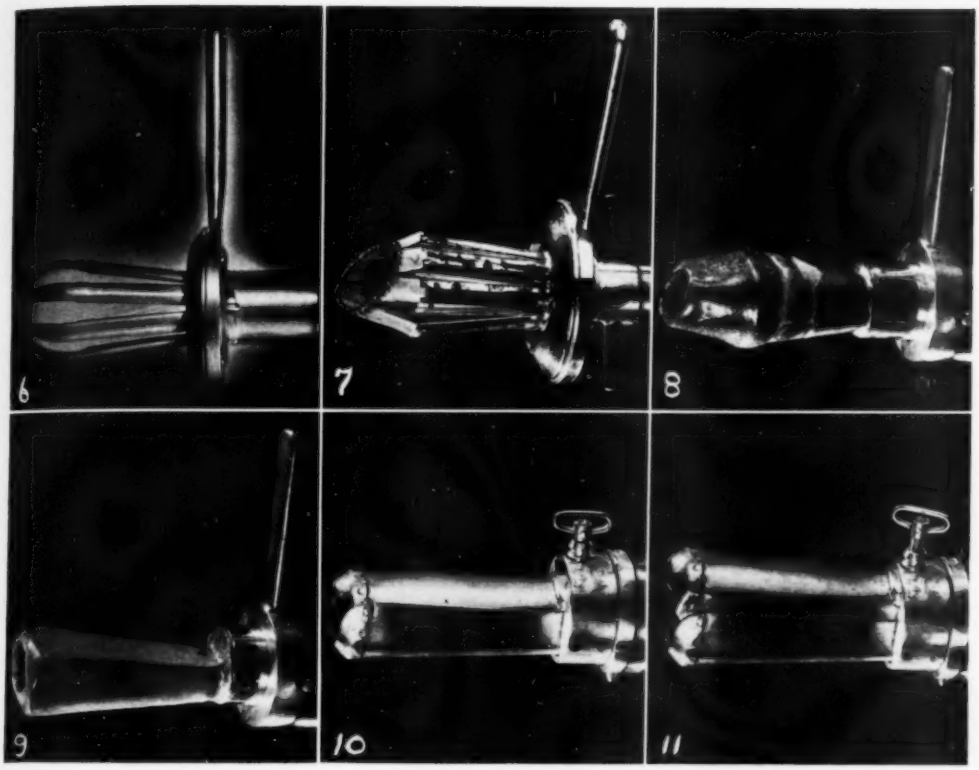


Figs. 4 and 5. Figure 4 (above) shows the distribution of radiation with transvaginal technic (first model, 4.5 cm. field). Figure 5 (below) shows, for comparison, the distribution with Chaoul's technic and with good radium technic (Mayneord).

vaginal fornices than the bladder and rectum, and since the size of the field is limited by the size of the introitus, it would be better to use an oval field than a circular one. I find it impossible to explain why this perfectly obvious fact was never recognized by any of us before. I spent most of the following summer making an expanding blade speculum, with the blades arranged in an ellipse instead of a circle. Since the lateral blades have to expand further than the anterior and posterior ones to keep the vaginal walls out of the axis of the flattened cone, it is a difficult mechanical problem and the resulting instrument was so cumbersome and so difficult to keep in order and adjustment that it was impracticable.

The next step was to develop the speculum shown in Figure 8. The part which is inserted into the vagina consists of two portions. The outer portion is made of iron and is in the shape of a flattened cone. The inner portion, which is approximately the same shape, is made of celluloid. This speculum gives adequate protection and is not uncomfortable. It is so cheaply and easily constructed that one can have it in many sizes. Its great disadvantage is that the dose at the edges of the field is very much lessened, because the rays must pass through the tissues surrounding the celluloid flattened cone. Studies of distribution show that the intensity at the edge of the field was reduced to about 30 per cent of the center.

In order to increase the dose to the lateral fornices the instrument shown in Figure 9 was devised. It exposes a half-oval field and is a compromise with the Wasson (8) multiple field technic. After the speculum has been introduced into the vagina and attached to the tube head, it is shifted toward its rounded side so that its opposite straight side is in the mid-line. The exposure is then made, the speculum is turned over without removing it from the vagina, and is shifted in the opposite direction for the second exposure. The instrument can be easily and cheaply constructed, gives adequate protection and good visibility, and is not too uncomfortable. The greatest circumference of the most frequently used medium-sized speculum is 15.5 cm., and the dimensions of the combined two half-oval fields exposed through it are 5.5 × 8 cm. Diminution of intensity at the edge of the field because the rays had to penetrate several centimeters of tissue before reaching the lateral fornices, a disadvantage common to all the previous models except the first one, was overcome by making the inner end of the speculum nearly square. The only



Figs. 6–11. Evolution of the improved speculum. Fig. 6. Speculum with curved duralumin blades. Fig. 7. Cylindrical speculum with hinged steel and aluminum blades. Fig. 8. Flattened-cone iron and celluloid speculum. Fig. 9. Half-oval iron and celluloid speculum. Figs. 10 and 11. Two-bladed expanding oval iron and aluminum speculum, closed (Fig. 10) and open (Fig. 11).

objection to this speculum is that it is difficult to be certain that the straight edges of the two half-oval fields coincide exactly, or that they do not overlap, at most, more than a centimeter.

Soon after starting to use the half-oval speculum, it became apparent that it is feasible and practicable to return to a simplification of the expanding blade principle, and I constructed the two-bladed oval speculum shown closed in Figure 10 and expanded in Figure 11. With expansion, the blades assume the shape of an oblong truncated pyramid with rounded corners. Although I use a 25 cm. anode-surface distance, the sides of the speculum coincide with a pyramid whose height is 35 cm. The reason for this apparently needless widening of the outer portion of the speculum is that in modern therapy tubes the focal spot is not a point. Its area is considerable. The two-bladed oval expanding speculum more nearly meets the requirements for a satisfactory instrument than any of the earlier models. These requirements are as follows:

1. Even exposure of a sufficiently large oval or oblong field.
2. Good visibility.
3. Comfort.
4. A short (not more than 30 cm.) anode-surface distance.
5. Rigidity.
6. Cheapness and simplicity.
7. Protection of the vulva.

Two sizes are enough for the great majority of patients. The larger, whose

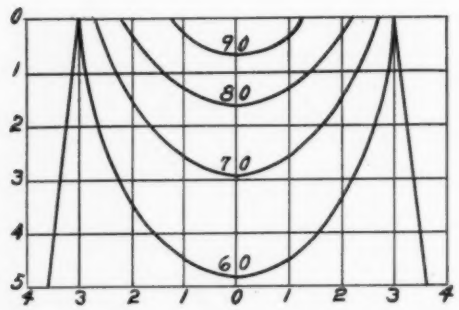


Fig. 12. Distribution of radiation with large expanding oval speculum.

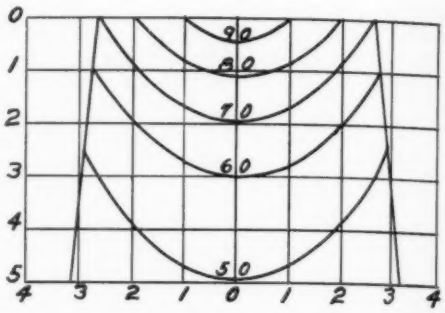


Fig. 13. Distribution of radiation with small expanding oval speculum.

greatest circumference, when closed, is 14.5 cm., exposes a field 5 × 6.5 cm. The smaller, whose circumference is 13 cm., exposes a field 3.75 × 5.25 cm. If neither can be inserted and expanded, I use one of the half-oval specula. The following physical factors are employed: kv. 200; ma. 20; A. S. D. 25 cm.; effective filter, Cu 0.75 mm.; hardness, expressed as half-value layer in copper, 0.9 mm. The distribution of the rays through the large and small two-bladed expanding oval specula is shown in Figures 12 and 13, respectively.

If these graphs are accurate, we should be able to deliver an aggregate dose of 6,000 r to the tissues at a depth of 3 cm. without producing necrosis of that portion of the cervix nearest the tube. With such dosage and distribution, we should be able to cure nearly all cervical cancer in Groups I and II. My own experience, while limited, seems to justify the foregoing theoretical conclusions. I can treat the lesions which can be completely included in the field with nearly as much confidence as I treat localized cancer of the lip. Of 22 patients treated before Jan. 13, 1939, 11 lived five years or longer. This 50 per cent five-year survival rate, while not spectacular, is satisfactory, since more than half of the patients were originally classified in Groups III and IV, and also because not all the deaths were from cancer.

A question which must have occurred to many is, can Group I and, perhaps, Group II cancers of the cervix be properly treated by the transvaginal method only, and the long, trying, expensive series of cross-fire treatments be omitted? Much might be said on either side of this question. If early cervical cancer can be properly treated with radium only, if ulcerating cancer of the lip can be properly treated by excision or irradiation without removal or irradiation of the cervical nodes, and if early breast cancer can be properly treated by operation without postoperative x-ray treatment, the answer to it should be "Yes."

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A Barium-Gelatine Mixture for the X-Ray Examination of the Digestive Tract[1]

LIEUT. MARTIN S. ABEL, M.C., A.U.S.

THE PRESENT experimental study of the use of liquid barium-gelatine mixtures for the routine roentgen-ray examination of the digestive tract was undertaken in the hope that it might prove possible to eliminate, so far as possible with station hospital facilities, the undesirable properties of the available barium and water mixtures and perhaps even improve on barium-acacia preparations, which were not available.

The first and foremost undesirable property of simple barium-water mixtures is the tendency of the barium to settle out of suspension. Because of this, it is necessary to use a fairly concentrated suspension of barium in an effort to outline a hollow viscus completely. When this effort is successful, the organ is rendered completely opaque, so that only defects fortuitously seen in profile will be diagnosed.

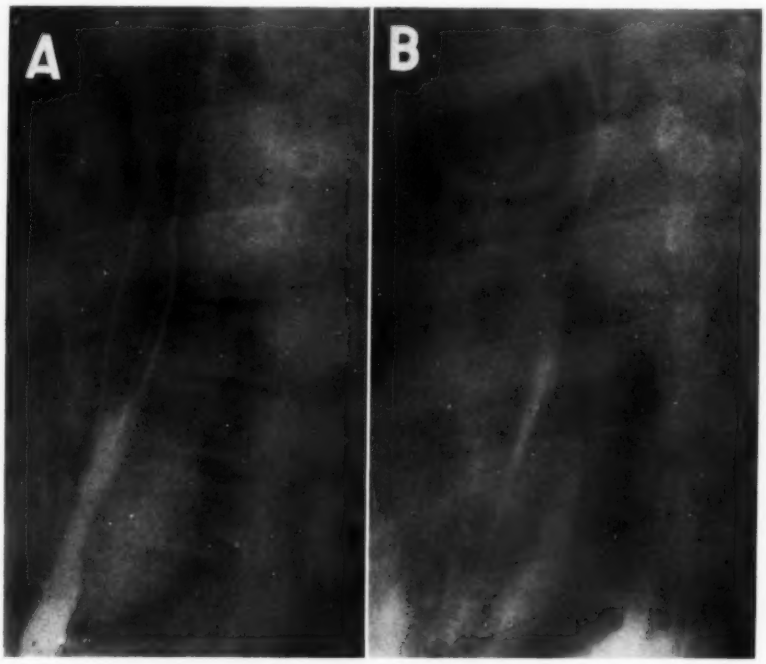

Fig. 1. Normal esophagram. A. Immediately after ingestion of barium-gelatine mixture. B. About 1 minute later.

Another highly undesirable property of the barium-water mixtures is their lack of adhesiveness to the walls of the gut. A simple suspension will pass along without leaving a discernible trace a moment after the bolus has passed. A medium that would stick to and outline the mucosal folds of the digestive tract for an appreciable interval would be most desirable. It is agreed that much information can be obtained from a mucosal study of the esophagus (4), stomach (5), or colon (3).

[1] From the X-Ray Department, Station Hospital, Mississippi Ordnance Plant, Jackson, Miss. Accepted for publication in December 1943.

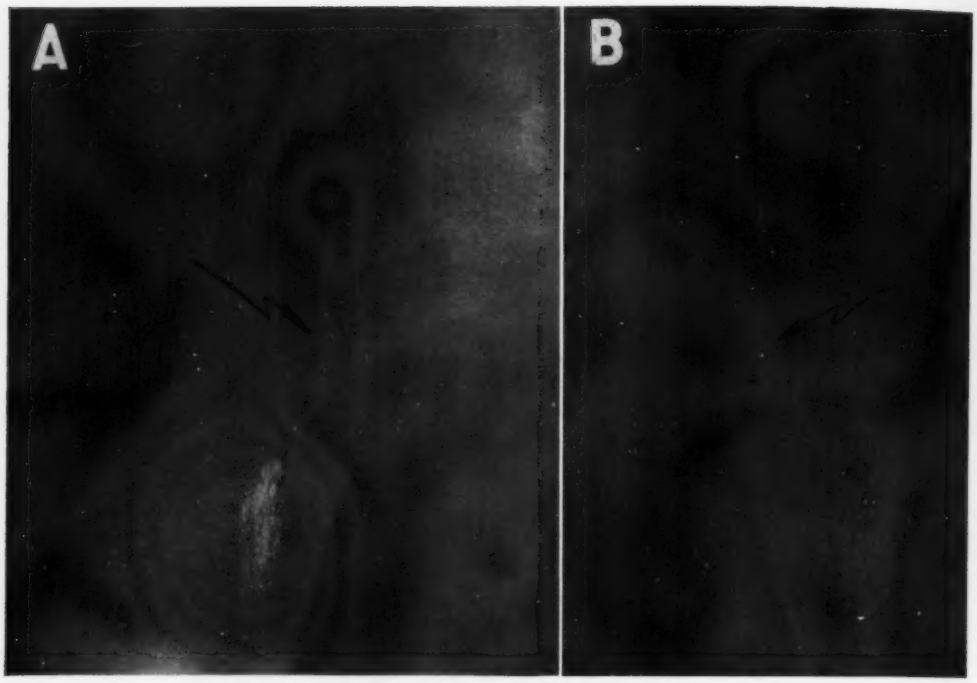

Fig. 2. A. Esophagram taken immediately after ingestion of radiopaque mixture, showing smooth pressure defect caused by pressure of mediastinal calcific mass, probably calcified lymph nodes at the bifurcation of the trachea. B. Film of same esophagus taken about 45 seconds later, showing pressure at the same place but no interruption of the mucosal folds passing through the region.

Many modifications of the simple barium-water mixtures have been devised to make a medium more desirable in one respect or another. The addition of a small amount of acacia will coat the particles of barium and make for a modified colloidal suspension which will not settle out so rapidly and will have a greater tendency to adhere to the walls of the gut (1). The use of air as a double contrast medium will frequently throw the mucosal folds of the colon into sharp relief (3). In outlining the esophagus, a somewhat thickened suspension will frequently coat the walls in such a way as to outline the folds properly, but the exact concentration often depends on the individual case (4). The use of hardened boluses of gelatine-barium of graded sizes has been recommended to show the site and diameter of an esophageal stricture (2). For a time, too, thorium oxide was in use as a desirable medium for demonstrating the mucosal pattern of the esophagus and colon (3).

In general, for specific parts of the alimentary tract and for specific conditions, special procedures have been adapted and individualized. Schatzki (4), in evaluating the difficulties of demonstrating mucosal defects of the esophagus associated with extramucosal tumors, points out that, if too much barium is given, the mucosal folds are obscured; if too little is given, the organ is not sufficiently distended, and even in the best of circumstances one must be fortunate in getting a picture that catches the bolus of barium just as it passes over the lesion.

Yet the type of lesion needing a very specialized technic for its detection is frequently the early, practically asymptomatic one—the one, in short, where a specialized technic would not be deemed necessary. The problem is especially im-

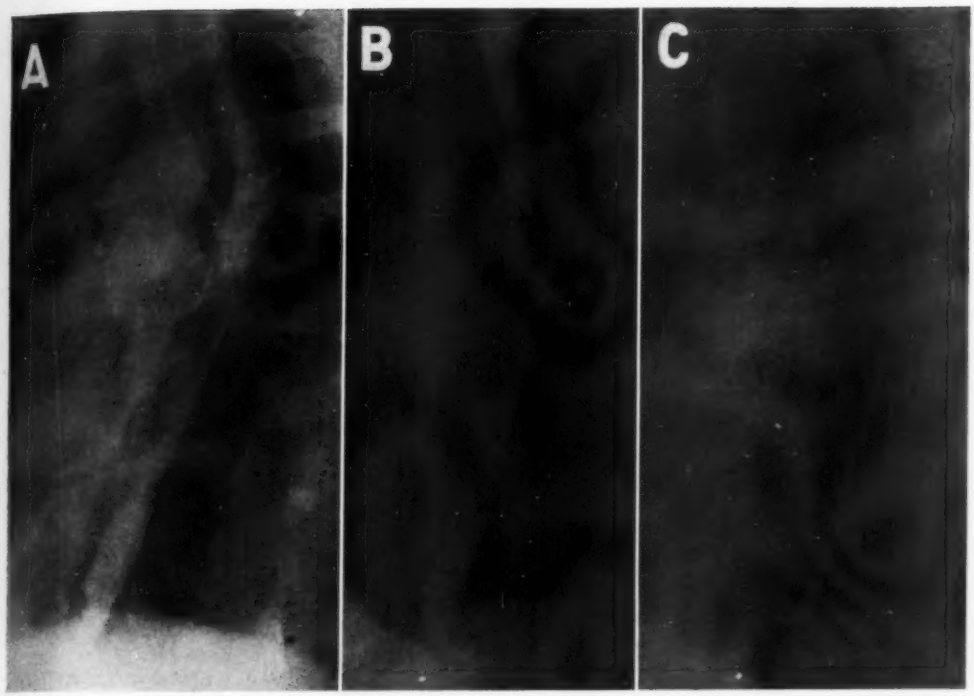

Fig. 3. A and B. Films of esophagus taken shortly after ingestion of barium-gelatin mixture, showing multiple patchy irregularities of distribution of the medium and multiple defects attributed to varicosities. C. Same esophagus about a minute after ingestion of mixture. Walls outlined by barium and lumen distended with air, showing clearly the outline of a distended varix.

portant in army practice, where few patients can have any but early lesions.

In view of these facts, it was felt that a definite need existed for a radiopaque medium which would be available, versatile enough for routine use, and at the same time capable of revealing early, slight lesions. Since a suspension of barium in water did not have the requisite properties, a search was made for a matrix for the barium which in itself would give the necessary adhesiveness and permanency of suspension. Gelatine was found to be such a material.

Gelatine will form a completely stable colloidal suspension in water over a wide range of concentrations, and barium will mix readily with such suspensions in practically all amounts. Moreover, unless they be very dilute in gelatine, such barium-gelatine-water suspensions will not settle out for long periods of time. In investigating their physical properties, it was found that the stickiness of the gelatine and its tendency to gel were relatively unaffected by the addition of the barium. Acid tended to keep the gelatine fluid, while alkali tended to solidify it. More than other acids, hydrochloric acid liquefied and digested the gelatine. Alcohol had a most profound solidifying effect on gelatine mixtures even in very low concentrations. In fact, after the addition of alcohol the barium could be mixed into a stable colloidal suspension only with difficulty.

It was realized, of course, that the gelatine would be digested in the stomach, disrupting the colloidal suspension, and that, since it is a food, it might conceivably alter gastro-intestinal motility. The time element was such, however, that the suspension should still offer some advantages in the stomach. In the esophagus after

oral ingestion and in the colon after an enema the mixture should remain stable.

Accordingly, a mixture was concocted with sufficient gelatine to give it a considerable amount of viscosity while containing enough barium to make it only semi-opaque. The technic of preparation is as follows:

Fig. 4. Normal colon study: pre-evacuation film showing colon outlined with semi-opaque medium, so that interior of gut can be partially visualized.

Two level tablespoonfuls of commercial gelatine[2] are added to about 1 1/2 glasses of hot water and stirred into solution. For all but very obese patients, three heaping tablespoonfuls of barium sulfate are added for oral use, or two for enema, and stirred into a fairly uniform suspension. To the resulting mixture are added 1 teaspoonful each of 95 per cent ethyl alcohol and a saturated solution of bicarbonate of soda. For oral use a few drops of vanilla extract are added. The whole is mixed thoroughly in the standard pint-size electric barium mixer. Sufficient air will be introduced in mixing to bring the volume up to a full pint. One pint is sufficient for the routine gastro-intestinal study; for a barium enema 3 pints are usually more than sufficient. The mixture should not be allowed to solidify but is more satisfactory after a slight preliminary chilling. It is also better to use it soon after mixing, before the air bubbles have escaped.

This gelatine-barium mixture has been in routine use for gastro-intestinal series and barium-enema studies for several months at the Station Hospital of the Mississippi Ordnance Plant. Approximately 100 oral studies and 12 barium-enema studies have been made during that time.

In our experience, orally administered the mixture attains its maximum advantages in study of the esophagus. Roentgenograms and fluoroscopy of the normal esophagus will show its entire length outlined at one time. Moreover, the mucosal folds will retain the barium for at least a minute or more after ingestion, and a delayed film will reveal the mucosal pattern well outlined. It was found that much gas is commonly swallowed with the mixture and held imprisoned in the esophagus, distending the walls, which are outlined by barium. The routine adopted was to take two films in esophageal studies—one immediately after ingestion of the barium, and one about forty-five seconds later. Since the mixture is rather thin, it is of more than usual importance to have the patient correctly *angled;* otherwise the esophageal shadow will be superimposed on the cardiac or spinal shadow and be very difficult to distinguish. Figure 1A is a film of a normal esophagus immediately after ingestion of the mixture; Figure 1B shows the same esophagus a little later, with most of the barium gone and the mucosal folds outlined. Both were taken in the upright position without a Bucky.

Unfortunately for an extensive study of the preparation, the patients encoun-

[2] Kindly donated by the Knox Gelatine Co.

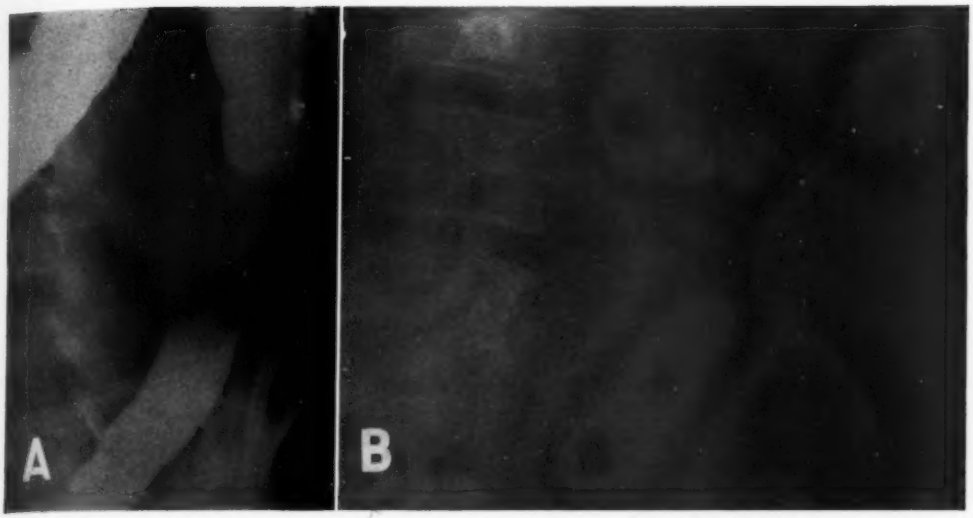

Fig. 5. Part of colon demonstrating diverticulosis. A. Pre-evacuation film showing plainly a diverticulum seen end on through gas and semi-opaque medium in the descending colon. B. Post-evacuation film, showing retained medium clearly demonstrating the multiple diverticula. Almost complete evacuation here is probably an evidence of increased irritability of the colon.

tered with esophageal abnormalities were few. Figures 2A and 2B show the esophagram of a patient with a mediastinal mass exerting pressure on the esophagus. In Figure 2B the mucosal folds show compression but no irregularity or interruption, confirming the extrinsic nature of the lesion. On the other hand, Figures 3A, 3B, and 3C show the defects in the walls of the esophagus and the distortion of the mucosal folds produced by some fairly early esophageal varices.

In the stomach the barium did not settle out as it had from simple barium-water mixtures, but the new medium probably offered no advantages over acacia-barium combinations. It was, however, quite satisfactory for routine use and proved entirely adequate for the diagnosis of the considerable number of peptic ulcers encountered. The gastric emptying time remained normal. The impression was that six-hour films show the stomach outlined with air rather more frequently than usual, but there was no adequate confirmation of this.

Films of the small and large intestines following oral administration were no better and no worse than those obtained with other mixtures. The small and large intestinal motility was apparently unaltered.

For the barium enema, the mixture was found to be decidedly advantageous. The walls of the colon are distended but not obscured by the semi-opaque medium. After evacuation, the mixture is held with great tenacity in the mucosal folds, so that they are invariably seen. They are most completely and delicately outlined in those regions where gas has collected. In order to have even approximately complete evacuation, it is well to allow the patient more than the usual amount of time. Figure 4 is a pre-evacuation film of a normal colon. Figures 5A and 5B are pre- and post-evacuation films of a colon with multiple diverticula. A solitary diverticulum shows well in the pre-evacuation film through the window of gas and semi-opaque medium. The patients encountered were not of the age group where colonic cancer would be frequently encountered, but it is hoped that this medium may be valuable for the early detection of such lesions.

SUMMARY AND CONCLUSIONS

1. A barium-gelatine-alcohol-bicarbonate of soda medium for the routine roent-

gen-ray study of the alimentary tract has been described. The mixture is designed to afford a viscous, sticky medium containing only enough barium to make it semi-opaque.

2. In routine oral administration to 100 patients at the Station Hospital, at the Mississippi Ordnance Plant this mixture was found to outline the esophagus with better definition of the mucosal folds and for a greater length of time than other media in use, with a corresponding increase in diagnostic value. For ingestion studies of the stomach and intestines the medium was felt to be at least on a par with other available materials.

3. On the basis of 12 barium-enema studies, it is felt that the new mixture possesses distinct advantages over other preparations in outlining fully with a semi-opaque medium the colon and its mucosal folds.

4. It is therefore concluded that the preparation described is to be recommended as a versatile and reliable medium for the routine roentgen-ray examination of all parts of the gastro-intestinal tract.

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EDITORIAL

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The Radiation Therapist in Contemporary Medicine

The use of x-rays and the radiations of radium in the treatment of disease has come to occupy a considerable proportion of the time and energy of the practising radiologist, to such an extent, indeed, that some physicians devote themselves exclusively to radiotherapy. Within broad limits, the status of these radiations as therapeutic weapons has been firmly established though subject to constant critical survey and revision. The present-day stability of this method of treatment makes it of some interest to inquire into the function and responsibilities of the physicians engaged in its use in clinical practice.

The obvious function of the radiation therapist may be defined as the planning, management, and execution of programs of irradiation in a diverse group of diseases with the major emphasis in the field of neoplasia. The connotations of this function are several-fold and they begin, not with the execution of a therapeutic program, but with diagnostic considerations. It is important to realize that, having accepted a patient for treatment by radiation methods, the ultimate responsibility for the accuracy of the diagnosis rests on the shoulders of the therapist, even though the diagnosis has been established by special methods beyond his capacity (either by virtue of lack of training, lack of special equipment, or lack of time for dealing with such methods). Even within the more restricted field of neoplasia, radiation therapy enters into so many diverse and specialized divisions of medicine that it is evident that the radiation therapist cannot be a master practitioner in all, from either a clinical or technical standpoint. He must depend upon his specially trained medical colleagues and must lean heavily upon the pathologist. Nevertheless, having accepted the patient for treatment, he assumes equal responsibility for the diagnosis with the colleague who has really established it.

In many instances, because of a rich experience with such material, he actually is in a better position to make the diagnosis than any other medical specialist—a fact which should not be overlooked. When this is not the case, the radiologist must none the less exercise his critical faculties in a review of the evidence upon which the diagnosis is based. Since "to err is human," even histologic diagnoses should be reviewed for compatibility with clinical manifestations. The occasion is not infrequent when the material upon which a histologic diagnosis is made is either not representative of the actual disease or is insufficient for adequate opinion.

The radiation therapist may exert a powerful influence on diagnostic accuracy in the field of neoplasia by persistent demand for positive histologic diagnoses in the numerous instances where this involves no harm to the patient, though some inconvenience may result. A further argument for precise diagnosis is found in the fact that in malignant neoplasia radiation treatment must be vigorous to the borderline of significant damage of normal structures. This borderline is more truly a zone of indefinite boundaries and on occasion serious damage to normal tissues will complicate the picture; such an occurrence on the basis of an incorrect diagnosis is unforgivable.

The execution of a planned program of irradiation is generally accepted as the

responsibility of the radiation therapist. The technical aspects of the administration of radiation are uniquely in his province. Sometimes there appears to be less agreement in regard to the determination of proper indications for irradiation and the planning of the radiation program. Objectively there can be no question that the final decision to proceed with irradiation should lie with the physician who carries the responsibility for its execution and who, therefore, is accountable for any possible resulting misadventure. The exigencies of the individual case will determine whether his aim is to be palliation of symptoms or eradication of the neoplasm. More or less tactful persuasion and coercion may be brought to bear upon him by his colleagues for administration of radiation in unsuitable cases. At times he may be requested to irradiate entirely hopeless lesions or lesions which do not respond, in order to create the delusion for the patient that something beneficial is being done. In the long run, such an approach serves only to discredit the method of treatment and by the example of failure may dissuade proper candidates for radiation therapy from seeking or accepting it. The transitory psychological benefit in the hopeless case must be balanced against the psychological and eventually physical harm to the group in which the method has real benefits to offer. It is the considered judgment of many that the use of radiation has no more validity than the use of surgery for such purposes.

Radiation therapy has developed beyond the stage in which the primary indication for its employment is inoperability. Sufficient advance has been made to provide clear-cut indications for irradiation as the primary, preferable, or sole method of treatment in many situations. As new therapeutic methods and technical refinements enter the clinical field, the indications for irradiation will alter; both expansion and contraction of the field may be anticipated. One must be foolhardy to insist that the peak of efficiency in radiation methods has been achieved. On the one hand, increased biological and biophysical knowledge and, on the other, the creation of new radiation weapons and technics open the door for continued progress in the field.

In planning the program of irradiation, the radiation therapist takes into account multiple factors, such as the anatomy and histopathology of the disease, the general condition of the patient, the physical characteristics of his radiation sources, and the defined objective of the treatment. In cases in which a desirable radiation program calls for surgical collaboration, it is apparent that the venture must be cooperative and the radiation attack may require modification in light of necessary surgical restrictions. On the other hand, the radiation program cannot suffer limitation because of a desire either on the part of the radiologist or his colleagues to avoid sharp radiation reactions. Fear of the requisite reactions in skin and other tissues is a relic of the past history of radiation therapy and, if it exists today, calls for education in the significance of such reactions.

In regard to the actual administration of radiation, one or two comments are in order. It would appear self-evident that the process of irradiation should be executed or closely supervised by the radiation therapist. Aside from making less likely accidents of over- or underdosage because of incorrect physical factors, such supervision insures the delivery of the radiation to the required site and the proper control of the dose in relation to the reaction of the lesion and the patient. Unexpectedly rapid responses, or the reverse, may throw doubt on the original diagnosis or may suggest the necessity for a change in the program. It should not be forgotten that in the weeks that are frequently required for the administration of radiation, sufficient time elapses for the manifestation of changes in the total clinical picture; new neoplastic metastases and extensions may appear, making it advisable to alter the original radiation program, or perhaps to abandon irradiation entirely. Unless close medical supervision

exists throughout the course of treatment, errors in treatment or management will inevitably follow.

The responsibilities of the radiation therapist do not end with the completion of the administration of radiation. Reactions must be followed to their termination; the regression or lack of regression of the neoplasm must be observed; periodically the patient must be examined to determine the presence of recurrences and metastases so that appropriate therapeutic measures may be undertaken at the earliest possible moment. Much of the follow-up work must be performed by the therapist, although, as in establishing a diagnosis, he may require aid in specialized types of examination. For certain situations his background of experience makes him more skillful than any of his colleagues in assessing the post-irradiation condition of a patient. The differentiation between recurrent neoplasm and post-irradiation sequelae is a case in point.

A larger duty rests on his shoulders than any immediate responsibility for the treatment of the individual patient. As in all fields of medicine, a portion of the progress that is achieved derives from the analysis, assessment, and criticism of clinical material and the results of clinical therapy. In the field of radiation treatment, this type of research is of considerable importance, since the underlying factor of interaction of living cells and radiation is of such great complexity as to make experimental control difficult. The primary basis for contemplated clinical investigation rests upon two factors: adequate records of the clinical, pathological, technical, and follow-up aspects of all cases and availability of the records for study.

Though little emphasis has been placed on the necessity of a mechanism for making case material directly or potentially available, its importance should not be underrated. Many a projected clinical investigation is defeated at the outset because of the inability to recover case material of the past or is severely handicapped because, with missing cases, interpretation may be faulty. With large volume, the opportunities for losing case material increase rapidly. Some method of currently indexing or codifying case records as they pass through the hands of the radiation therapist represents an investment which should deliver rich dividends in future clinical investigation.

Radiation therapy, as practised today, cuts across the division of medicine into the various specialties. The radiation therapist, in the field of neoplasia, enters into the fields of general medicine, pediatrics, dermatology, and the multiple subdivisions of modern surgery. Because of this, he has an opportunity of acquiring a comprehensive view of neoplasia which may be denied his colleagues and he may well serve as a co-ordinating agency for tying together a store of knowledge unshackled by the limitations imposed by the classical subdivisions of medicine. In this respect the radiation therapist in many ways has a vantage point similar to that of the pathologist with, however, the inclusion of a therapeutic as well as a diagnostic point of view. His unique position in this field ably qualifies him as a valuable consultant in diagnostic and therapeutic problems, and it will be to the advantage of medical practice and progress in general if his medical colleagues recognize and utilize these consultative potentialities.

ISADORE LAMPE, M.D.
Department of Roentgenology
University of Michigan

JOINT MEETING

RADIOLOGICAL SOCIETY OF NORTH AMERICA

in conjunction with

THE AMERICAN ROENTGEN-RAY SOCIETY

Chicago, Ill., Sept. 25–29

Monday, September 25

GENERAL ASSEMBLY, 10:30 A.M.

Presiding: Sherwood Moore, M.D., President, American Roentgen Ray Society

Secretary of Session: Dabney Kerr, M.D.

1. Call to Order, SHERWOOD MOORE, M.D., St. Louis, Mo.
2. Greetings, JOSIAH J. MOORE, M.D., President Chicago Medical Society, Chicago, Ill.
3. Response, ELDWIN R. WITWER, M.D., Chairman Co-ordinating Committee, Detroit, Mich.
4. Address: A Study of the Ureters in Bladder Neck Obstructions, HERMAN L. KRETSCHMER, M.D., President American Medical Association, and FAY H. SQUIRE, M.D., Chicago, Ill.
5. Address, Col. B. R. KIRKLIN, M.C., A.U.S., representing Major-General NORMAN T. KIRK, Surgeon-General, M.C., A.U.S., Washington, D. C.
6. Address: Pantopaque Myelography: Correlation of Roentgenological and Neurosurgical Findings, Lt. Comdr. ROBERT K. ARBUCKLE, M.C., U.S.N.R. (representing Vice-Admiral ROSS T. MCINTIRE, Surgeon-General, M.C., U. S. Navy), Lt. C. H. SHELDEN, M.C., U.S.N.R., and Lt. R. H. PUDENZ, M.C., U.S.N.R., Bethesda, Md.

DIAGNOSTIC SECTION, 2:00 P.M.

THE CHEST

Presiding: Eldwin R. Witwer, M.D.

Secretary of Session: David Beilin, M.D.

1. Progressive Bilateral Bullous Emphysema, GEORGE TEPLICK, M.D. (by invitation), and ALISON PRICE, M.D. (by invitation), Philadelphia, Penna.
2. Non-Disabling Bronchiectasis, Major ARCHIE FINE, M.C., A.U.S., National Army Air Center, Nashville, Tenn.
3. Roentgenograms of the Chest in Mental Deficiency, JOSEPH T. DANZER, M.D., Oil City, Penna.

Recess, 3:30 to 4:00 P.M.

4. Planigraphy: An Evaluation of the Method in the Diagnosis of Cancer of the Lower Respiratory Tract, J. ROBERT ANDREWS, M.D., Cleveland, Ohio, and Capt. ROBERT O. TUREK, M.C., A.U.S. (by invitation).
5. Roentgenological Aspect of Tuberculous Calcification: A Clinical and Experimental Study, ROBERT G. BLOCH, M.D. (by invitation), Chicago, Ill.
6. Miniature Chest Fluorography with Control Study, HARRY HAUSER, M.D., and CARROLL C. DUNDON, M.D. (by invitation), Cleveland, Ohio.

THERAPEUTIC SECTION, 2:00 P.M.

Presiding: U. V. Portmann, M.D.

Secretary of Session: John S. Bouslog, M.D.

1. Value of Orchiectomy in Treatment of Carcinoma of the Male Breast, T. LEUCUTIA, M.D., Detroit, Mich.
2. Testicular Irradiation in Carcinoma of the Prostate, ARBOR D. MUNGER, M.D., (by invitation), Lincoln, Neb.
3. An Improved Technic for the Treatment of Carcinoma of the Testis, Major MILTON FRIEDMAN, M.C., A.U.S., and Lt. Col. L. G. LEWIS, M.C., A.U.S. (by invitation), Washington, D. C.

Recess, 3:30 to 4:00 P.M.

4. Review of Sixty-five Cases of Malignant Tumors of the Testes, Major J. L. BARNER, M.C., A.U.S., Atlanta, Ga.
5. Contact Roentgen Therapy for Carcinoma of the Bladder, LOWELL S. GOIN, M.D., Los Angeles, Calif.
6. Roentgen Therapy in Marie-Strümpell Spondylarthritis (Spondylitis Rhizomelica), ROBERT J. REEVES, M.D., AND JAMES E. HEMPHILL, M.D. (by invitation), Durham, N. C.

Tuesday, September 26

GENERAL ASSEMBLY, 10:30 A.M.

Presiding: Eldwin R. Witwer, M.D.

Secretary of Session: Donald S. Childs, M.D.

1. Installation of President-Elect of the American Roentgen Ray Society, LYELL C. KINNEY, M.D., by SHERWOOD MOORE, M.D., President A.R.R.S., and CHARLES H. HEACOCK, M.D., Chairman Executive Council, A.R.R.S.

2. Inaugural Address, LYELL C. KINNEY, M.D., President American Roentgen Ray Society.
3. Roentgen-ray Examination of the Urinary Tract, with Special Reference to Methods and Findings in Cases of Testicular Tumors, Lt. Col. JOSEPH C. BELL, M.C., A.U.S., Major GILBERT W. HEUBLEIN, M.C., A.U.S. (by invitation), and Capt. HOWARD J. HAMMER, M.C., A.U.S. (by invitation), Percy Jones General Hospital, Battle Creek, Mich.
4. X-Ray Findings in Chest Examinations of 120,000 Government Employees, WALDRON SENNOTT, M.D., P/A Surgeon, U.S.P.H.S., U. S. Marine Hospital, Staten Island, N. Y., representing Surgeon-General THOMAS PARRAN, U.S.P.H.S.
5. Radiation Necrosis of the Skull, Comdr. JOHN D. CAMP, M.C., U.S.N.R., U. S. Naval Hospital, Oakland, Calif.
6. Coccidioides Infection of the Lungs, Lt. Col. JOHN L. DAVIS, M.C., A.U.S. (by invitation), Capt. IVAN A. MUNK, M.C., A.U.S. (by invitation), and Capt. SAMUEL H. BOYER, M.C., A.U.S., Camp Haan, Riverside, Calif.

DIAGNOSTIC SECTION, 2:30 P.M.

THE GASTRO-INTESTINAL TRACT

Presiding: Lyell C. Kinney, M.D.

Secretary of Session: Charles H. Heacock, M.D.

1. Antral Gastritis: Roentgenologic and Gastroscopic Findings, WALTER W. VAUGHAN, M.D., Durham, N. C.
2. Congenital Duodenal Obstruction, ERNEST KRAFT, M.D., FRIEDRICH G. KAUTZ, M.D. (by invitation), and JAMES R. LISA, M.D. (by invitation). New York, N. Y.
3. Diaphragmatic Hernia and Dilated Esophageal Ampulla: Their Clinical Significance, JACOB ABOWITZ, M.D., Los Angeles, Calif.
4. Diverticula of the Small Intestine, MAX RITVO, M.D., Boston, Mass.
5. Regional Ileitis, SAMUEL BROWN, M.D., Cincinnati, Ohio.
6. Differential Diagnosis Between Benign and Malignant Gastric Ulcers, LEWIS GREGORY COLE, M.D., White Plains, N. Y.

THERAPEUTIC SECTION, 2:30 P.M.

Presiding: Heddy S. Shoulders, M.D.

Secretary of Session: James N. Collins, M.D.

1. Hematological and Clinical Characteristics of Leukemias, RUSSELL L. HADEN, M.D. (by invitation), Cleveland, Ohio.
2. Clinical and Hematological Observations on One Hundred Patients with Various Types of Blood Dyscrasias Treated with Radioactive Phosphorus, E. H. REINHARD, M.D. (by invitation), and C. V. MOORE, M.D. (by invitation), St. Louis, Mo.
3. Leukemia: Results of Roentgen-Ray Treatment, BERNARD P. WIDMANN, M.D., Philadelphia, Penna.
4. Experimental Production of Leukemia with X-Rays, P. S. HENSHAW, Ph.D. (by invitation), Bethesda, Md.
5. Some Studies with Radioactive Sodium in Leukemic and Non-Leukemic Mice, EDITH H. QUIMBY, Sc.D., and TITUS C. EVANS, Ph.D., New York, N. Y.
6. Metabolic Changes Produced in Man by X-Rays (to be read by title), ANNA GOLDFEDER, M.D. (by invitation), New York, N. Y.

CALDWELL-CARMAN LECTURE, 8:30 P.M.

Lawrence Reynolds, M.D.
Detroit, Mich.

Wednesday, September 27

GENERAL ASSEMBLY, 10:30 A.M.

Presiding: Lyell C. Kinney, M.D.

Secretary of Session: Dabney Kerr, M.D.

1. Address, ELDWIN R. WITWER, M.D., President Radiological Society of North America, Detroit, Mich.
2. Some Considerations Concerning the Roentgen Examination of the Head, EUGENE P. PENDERGRASS, M.D., and CHARLES R. PERRYMAN, M.D. (by invitation), Philadelphia, Penna.
3. Radiological Aspects of Public Health Work, HERMAN E. HILLEBOE, M.D. (by invitation), and RUSSELL H. MORGAN, M.D. (by invitation), Bethesda, Md.
4. Roentgen Changes Associated with Pancreatic Fibrosis, EDWARD D. NEUHAUSER, M.D. (by invitation), Boston, Mass.
5. Radioactive Sodium as a Tracer in the Study of Peripheral Vascular Disease, BEVERLY C. SMITH, M.D. (by invitation), and EDITH H. QUIMBY, Sc.D., New York, N. Y.
6. Streamlining X-Ray Therapy for Wartime Service, Capt. ALBERT SOILAND, M.C., U.S.N.R., U. S. Naval Hospital, Oakland, Calif.
7. X-Ray Demonstration of Cecal Deformity in Amebiasis, ROSS GOLDEN, M.D., and PAUL H. DUCHARME, M.D. (by invitation), New York, N. Y.

DIAGNOSTIC SECTION, 2:00 P.M.

THE OSSEOUS SYSTEM

Presiding: Edgar P. McNamee, M.D.

Secretary of Session: Harold G. Reineke, M.D.

1. Differential Diagnosis of Tuberculosis in Joints of the Extremities, RAYMOND LEWIS, M.D., New York, N. Y.
2. Derangements of the Knee. Diagnostic Scope of Soft-Tissue Examination with the Vacuum Tech-

nic, Lt. Comdr. J. GERSHON-COHEN, M.C., A.U.S., U. S. Naval Hospital, Sampson, N. Y.

3. Post-Traumatic Para-Articular Calcifications and/or Ossifications of the Ankle, Capt. ARNOLD D. PIATT, M.C., A.U.S., Fort Myers, Fla.

Recess, 3:30 to 4:00 P.M.

Review Exhibits

4. Development of Bone Sarcoma Following Irradiation, C. HOWARD HATCHER, M.D. (by invitation), Chicago, Ill.
5. Lesions of the Intervertebral Disk in the Cervical Region, J. E. WHITELEATHER, M.D., R. E. SEMMES, M.D. (by invitation), and FRANCIS MURPHEY, M.D. (by invitation), Memphis, Tenn.
6. Roentgenographic Observations in Age Atrophy (Osteoporosis) of the Spine, G. J. MARUM, M.D. (by invitation), Greenville, Miss.
7. Deossifications Regional to Joints of Extremities, Col. A. A. DE LORIMIER, M.C., A.U.S., Memphis, Tenn.

THERAPEUTIC SECTION, 2:00 P.M.

Presiding: Robert S. Stone, M.D.

Secretary of Session: Edgar C. Baker, M.D.

1. Roentgen Therapy for Brain Tumors, PERCIVAL BAILEY, M.D. (by invitation), and T. J. WACHOWSKI, M.D., Chicago, Ill.
2. Roentgen Therapy of Primary Neoplasms of the Brain and Brain Stem, C. B. PEIRCE, M.D., W. V. CONE, M.D. (by invitation), A. R. ELVIDGE, M.D. (by invitation), and J. C. TYE, JR., M.D. (by invitation), Montreal, Canada.
3. Neurosurgical Treatment of Patients with Advanced Malignant Disease, GAYLE CRUTCHFIELD, M.D. (by invitation), University, Va.

Recess, 3:30 to 4:00 P.M.

4. Irradiation of Pituitary Tumors, W. S. LAWRENCE M.D., Memphis, Tenn.
5. Roentgen Therapy of Encephalitis, U. V. PORTMANN, M.D., and ROGER LOUGH, M.D. (by invitation), Cleveland, Ohio.
6. Simplification of Tissue Dose Estimation in X-Ray Therapy, ANNA HAMANN, M.D. (by invitation), Chicago, Ill.

Thursday, September 28

GENERAL ASSEMBLY, 10:30 A.M.

Presiding: Eldwin R. Witwer, M.D.

Secretary of Session: Donald S. Childs, M.D.

1. The Morgan X-Ray Exposure Meter and Phototimer, PAUL C. HODGES, M.D., Chicago, Ill.
2. Scout Film of the Abdomen, Lt. Col. JOSEPH LEVITIN, M.C., A.U.S., Camp Cooke, Calif.
3. Clinical Cineradiography: Brazilian Method, JOSÉ JANY, M.D. (by invitation), and JOAQUIN MARTINEZ GARCIA, M.D., Radiologist, Official Delegate, Ministry of Aeronautics (by invitation), Sao Paulo, Brazil.
4. Analysis of Factors Affecting the Diagnostic Quality of the Roentgen Image, RUSSELL H. MORGAN, M.D. (by invitation), Bethesda, Md.
5. Importance of Recognized Protrusions of the Gastric Mucosa in Military Personnel, Comdr. WENDELL SCOTT, M.C., U.S.N.R., U. S. Naval Hospital, Seattle, Wash.
6. Abdominal Aortography; A New Simplification of the Technic, PEDRO L. FARIÑAS, M.D., Habana, Cuba.

DIAGNOSTIC SECTION: 2:30 P.M.

Presiding: Lewis G. Allen, M.D.

Secretary of Session: W. Walter Wasson, M.D.

1. Roentgen Anatomy of the Skull in the Newborn Infant, SAMUEL G. HENDERSON, M.D., and LOUISE M. SHERMAN, M.D. (by invitation), Pittsburgh, Penna.
2. Midline Anomalies of the Brain, ARTHUR P. ECHTERNACHT, M.D., and JOHN A. CAMPBELL, M.D. (by invitation), Indianapolis, Ind.
3. Lesions of the Aqueduct of Sylvius, HUGH WILSON, M.D. (by invitation), New Haven, Conn.
4. Tuberous Sclerosis of the Brain, A. W., MARCOVICH, M.D. (by invitation), AND EARL WALKER, M.D. (by invitation), Chicago, Ill.
5. Observations on the Presence of Subdural Gas After Pneumoencephalography, LESTER W. PAUL, M.D., and T. C. ERICKSON, M.D. (by invitation), Madison, Wis.

THERAPEUTIC SECTION, 2:30 P.M.

Presiding: Zoe A. Johnston, M.D.

Secretary of Session: Leland E. Holly, M.D.

1. Results of Irradiation Treatment of Ovarian Tumors, H. DABNEY KERR, M.D., and R. A. J. EINSTEIN, M.D. (by invitation), Iowa City, Iowa.
2. Problem of Secondary Infection in Carcinoma of the Cervix, MANUEL GARCIA, M.D. (by invitation), and J. V. SCHLOSSER, M.D. (by invitation), New Orleans, La.
3. Irradiation Failures in Early Carcinoma of the Cervix. Is Surgery or Irradiation Preferable? FRANZ BUSCHKE, M.D. (by invitation), and S. T. CANTRIL, M.D., Seattle, Wash.
4. Indications and Limitations of Transvaginal Roentgen Therapy for Cancer of the Cervix, ARTHUR W. ERSKINE, M.D., Cedar Rapids, Iowa.
5. Bone Tumors: Review of Cases from Bellevue Hospital, New York, RIEVA ROSH, M.D., and LOUIS RAIDER, M.D. (by invitation), New York, N.Y.

BANQUET, 8:00 P.M.

Grand Ball Room

Presiding: Edward L. Jenkinson, M.D., Chicago, Ill.

FRANKLYN B. SNYDER, President Northwestern University, Chicago, Ill.

Introduction of newly elected officers and members of the Executive Council of the American Roentgen Ray Society by LYELL C. KINNEY, M.D., San Diego, Calif.

Introduction of newly elected officers and members of the Board of Directors of the Radiological Society of North America by ELDWIN R. WITWER, M.D., Detroit, Mich.

Installation of the President of the Radiological Society of North America, LEWIS G. ALLEN, M.D., Kansas City, Kans., by ELDWIN R. WITWER, M.D., Detroit, Mich.

Resolutions

Friday, September 29

GENERAL ASSEMBLY, 10:30 A.M.

Presiding: Lyell C. Kinney, M.D.

Secretary of Session: Dabney Kerr, M.D.

1. Osteochondritis Dissecans of the Supratrochlear Septum of the Humerus, Lt. Comdr. W. E. CRYSLER, A/Surgeon, R.C.N.V.R. (by invitation), and Surgeon-Comdr. H. S. MORTON, R.C.N.V.R. (by invitation), Esquimalt, British Columbia.
2. Subcortical Cyst-like Lesions of Joints, DALLAS B. PHEMISTER, M.D. (by invitation), Chicago, Ill.
3. Cardiac Changes in Arteriovenous Fistula, Major R. C. PENDERGRASS, M.C., A.U.S., Ashford General Hospital, White Springs, Va.
4. Cystourethrography, FRED A. COE, M.D., Washington, D. C.
5. Roentgenological Aspects of Therapeutic Pneumoperitoneum, ERNST A. SCHMIDT, M.D., Denver, Colo.
6. Relaxation of Intrinsic Spasm in Pyloroduodenal Area, LESTER A. SMITH, M.D., Indianapolis, Ind.

DIAGNOSTIC SECTION, 2:30 P.M.

Presiding: Eldwin R. Witwer, M.D.

Secretary of Session: Warren W. Furey, M.D.

1. Roentgen Appearances in Collapse of the Lung and Its Subdivisions: Preliminary Report, LAURENCE L. ROBBINS, M.D. (by invitation), and CLAYTON H. HALE, M.D. (by invitation), Boston, Mass.
2. Gas Gangrene, Capt. MAURICE D. SACHS, M. C., A.U.S., Port of Embarkation, San Francisco, Calif.
3. Extrapleural Pneumothorax in the Treatment of Pulmonary Tuberculosis: Three- to Five-Year Follow-up of 48 Cases, F. H. ALLEY, M.D. (by invitation), Memphis, Tenn.
4. Some Experiences with Angiography, EARL R. MILLER, M.D., San Francisco, Calif.
5. Specifications for the Fluoroscopist's Dark Adaptation Goggles, W. EDWARD CHAMBERLAIN, M.D., and ANN CHAMBERLAIN (by invitation), Philadelphia, Penna.
6. Unusual Urinary Calculi, E. J. BERTIN, M.D., Philadelphia, Penna.

THERAPEUTIC SECTION, 2:00 P.M.

Presiding: Charles H. Heacock, M.D.

Secretary of Session: Clyde K. Hasley, M.D.

1. Treatment of Hemangiomas, G. E. PFAHLER M.D., Sc.D., LL.D., Philadelphia, Penna.
2. Treatment of Hemangioma with Roentgen Rays, JAMES V. PROUTY, M.D., Cedar Rapids, Iowa.
3. Cancer of the Skin, HENRY J. ULLMANN, M.D., Santa Barbara, Calif.
4. Post-irradiation Cutaneous Necrosis: A Study of Its Mechanism, Course and Treatment, H. B. HUNT, M.D., and D. H. BREIT, M.D. (by invitation), Omaha, Neb.
5. The Radon Ointment Treatment of Irradiation Ulcers, ROBERT E. FRICKE, M.D., and MARVIN M. D. WILLIAMS, Ph.D. (by invitation), Rochester, Minn.
6. Evaluation of Roentgen Therapy for Filariasis, Lt. H. L. JAFFE, M.C., U.S.N.R. (by invitation), San Diego, Calif.

JOINT MEETING AMERICAN ROENTGEN RAY SOCIETY and RADIOLOGICAL SOCIETY OF NORTH AMERICA

Elsewhere in this issue there appears a Preliminary Program for the Joint Meeting to be held in September. For the Radiological Society of North America this will be the Thirtieth Annual Meeting.

The requests of the various committees for contributions to the Program resulted in a most generous response, and we sincerely regret our inability to find time for formal presentation of all the papers that have been submitted.

The importance of roentgenology in the various branches of military service is evident from the many papers and exhibits coming from radiologists in the Armed Forces and various departments of the Public Health Service.

Thirty-three applications have been received for space in the Scientific Exhibits. These exhibits cover many phases in the more recent development of diagnostic and therapeutic roentgenology.

The Refresher Courses, outlined in the July issue of RADIOLOGY, offer opportunity for concentrated and specialized instruction in some of the more difficult and interesting phases of Radiology. These courses will be under the direction of highly qualified instructors.

The Commercial Exhibit gives every promise of being one of great interest. New devices, many of them resulting from experience gained in military activities, will be displayed and demonstrated.

ELDWIN R. WITWER, M.D., *President*
Radiological Society of North America
LYELL C. KINNEY, M.D., *President*
American Roentgen Ray Society

MOBILE X-RAY UNITS FOR INVASION

The following news item appearing in a recent issue of the *Journal of the American Medical Association* will be of special interest to Doctor Allen's fellow members in the Radiological Society of North America.

"After several months of experimentation the European theater of operations chief surgeon's office has announced that mobile x-ray units will follow American troops onto the continent. Lieut. Col. Kenneth D. A. Allen of Denver, who conceived the idea in 1943 and followed it through successfully, stated that the primary purpose of the mobile units, as in all medical corps work, is to keep men in the fighting front by prompt, accurate diagnosis and by location of foreign bodies and to save lives. Hospitals in the field are unable to carry enough x-ray equipment to handle peak loads of patients, so mobile units will be rushed to them when needed. They may also be sent to clearing stations where no x-ray equipment is available. The personnel consists of one medical officer, a specialist in x-ray work and three enlisted men. Two blacked-out tents attached to a tarpaulin covering the back of the truck serve as patients' waiting rooms and picture-taking rooms. The back end of the truck is used for developing and drying x-ray films. Generators furnish power for drying film, for control of water temperature, for lighting and for powering the x-ray machine. Capt. Charles D. Rancourt of Albany, N. Y., who assisted Colonel Allen in the construction of the unit, has been demonstrating the original unit before hundreds of medical corpsmen. Colonel Allen, senior consultant in radiology to the theater chief surgeon, has been in the Army since May 1942. He taught in the x-ray school at Fitzsimons General Hospital in Denver until he went to England in January 1943."

Letters to the Editor

DYSCHEZIA AND MEGACOLON

The following letter from Sir Arthur Hurst is in response to one by Dr. Percy J. Delano, appearing in the February issue of RADIOLOGY (**42:** 190, 1944).

To the Editor

Sir:

I have read most of the literature on intestinal disorders published in English, French, and German since 1909, and Dr. Delano is the only author I have come across who has confused dyschezia with megacolon. I should like to refer him to the second volume of Dr. Bockus's monograph on Gastro-Enterology, published this year, in which the author opens his discussion on the causes of constipation with a summary of my classification, which he accepts in its entirety. He also favours my views about megacolon, and makes extensive reference to my work on the subject.

My statement that megacolon is rare in children is borne out by the fact that one was found in only 3 out of 30,000 consecutive autopsies (Fenwick) and in only 1 in every 2,620 in-patients (Lightwood) at the Hospital for Sick Children in London. Megacolon is almost unknown in little girls, but is as common in adult women as in adult men; it is clear, therefore, that most cases in adults are acquired and not congenital.

Dr. Delano does not appear to realise that the anal sphincter actively relaxes during defaecation, and it is the absence of this relaxation (achalasia) that results in retention of gas and faeces and the development of megacolon. There is no spasm,

so no hypertrophy occurs, and the finger meets with no more resistance than is offered by the normal closed sphincter.

With regard to treatment by sympathectomy, this has now been entirely superseded in England by non-operative treatment, as it is recognized that the operation had no effect beyond mutilating a boy so that he is impotent when he grows up. The apparent benefit to the bowel condition was a result of the spinal anaesthesia. Telford, who had performed the operation more frequently than anybody else in this country, has not done it once since he found eight years ago that equally good results followed a spinal anaesthetic without any operation.

Yours faithfully,
ARTHUR HURST, M.D.

PERCENTAGE OF DISABILITY

To the Editor:

In the capacity of expert witnesses or as medical referees we are frequently asked to give an opinion as to the percentage of disability in a given case or to state the amount of physical damage resulting from the condition which we have diagnosed. Under ordinary circumstances our opinion or estimate can be little better than a guess, unless we have some definite means of computation, based upon a recognized or at least a promulgated rule.

In the course of a discussion of this subject several years ago with an unusually level-headed friend (Dr. Lucien Stark, of Norfolk, Neb.), he outlined what appealed to me as a sane and practical method of computing disability in either limb. According to this scheme the allowance is 25 per cent for each leg, 20 per cent for the left arm and/or hand, and 30 per cent for the right arm and/or hand in right-handed persons (reversing the figures if the injured person is left-handed), making a total of 100 per cent.

If the injury or defect is to the right hand, one notes what functions or forms of work usually performed by the injured person he is now unable to perform because of the disability or defect. The sum total of this disability is then deducted from 100 per cent, which represents the full use of the injured limb. Thus if in the injured right arm and hand the disability is found to be 60 per cent, leaving only 40 per cent of the normal function of the right hand, we have 18 per cent total liability. If the disability is permanent and the life expectancy is twenty-five years, the total cash settlement should be 18 per cent of the annual wages multiplied by 25.

For example: A farm hand of 35 received an injury to his right forearm, in which the ulnar nerve was severed and not sutured, resulting in a permanent contraction of the ring and little fingers. He was unable to milk, handle a pitchfork, hammer, or axe, or anything requiring the full strength and use of the right hand. Suppose we decide that he has 60 per cent disability in the right hand and arm. At 35 his life expectancy is 96 minus his age divided by 2, or roughly 30 years. He was earning $50 per month or $600 per year; but because of his 18 per cent disability (or only 82 per cent efficiency) his annual earning capacity is reduced permanently to $492, or a loss of $108. He should therefore receive $108 per year for the rest of his life, or a lump sum of $3,240.

I have applied this method in a few instances while acting as a referee and found that both parties to the argument agreed that the method was equitable and satisfactory. When I explained it to the jury in a recent personal injury suit, both the jurors and the judge nodded their heads approvingly and a verdict was rendered for the exact sum I had estimated, plus a liberal amount for the plaintiff's sufferings.

Yours very truly,
I. S. TROSTLER, M.D.

Books Received

THE PATHOGENESIS OF TUBERCULOSIS. By ARNOLD R. RICH, M.D., Associate Professor of Pathology, The Johns Hopkins University School of Medicine, Baltimore. A volume of 969 pages; 35-page index; 89 figures; 20 tables; 1417 references; 4 charts. Published by Charles C Thomas, Springfield, Ill. Price $10.50 postpaid.

FERTILITY IN MEN. A CLINICAL STUDY OF THE CAUSES, DIAGNOSIS, AND TREATMENT OF IMPAIRED FERTILITY IN MEN. By ROBERT SHERMAN HOTCHKISS, B.S., M.D., Lieutenant Commander (M.C.), U.S.N.R. (on active service); Assistant Professor of Urology, New York University Medical College; Instructor in Surgery (Urology), Cornell Medical College; Assistant Visiting Attending, Department of Urology, Bellevue Hospital; Assistant Visiting Attending in Surgery (Urology), New York Hospital; Chief of Urological Clinic, New York University Medical College Clinic. Foreword by Nicholson J. Eastman, M.D., Chairman, Editorial Committee, National Committee on Maternal Health; Professor of Obstetrics in Johns Hopkins Hospital. A volume of 216 pages, with 95 illustrations. Published by the J. B. Lippincott Company, Philadelphia. Price $3.50.

FERTILITY IN WOMEN. CAUSES, DIAGNOSIS AND TREATMENT OF IMPAIRED FERTILITY. By SAMUEL L. SIEGLER, M.D., F.A.C.S., Attending Obstetrician and Gynecologist, Brooklyn Women's Hospital; Attending Gynecologist, Unity Hospital; Assistant Obstetrician and Gynecologist, Greenpoint Hospital; Attending Sterility Clinic, Greenpoint Hospital; Consultant in Gynecology, Rockaway Beach Hospital; Diplomate American Board of Obstetrics and Gynecology; Fellow, New

York Academy of Medicine; Member, Society for the Study of Internal Secretions. Foreword by Robert Latou Dickinson, M.D. A volume of 450 pages, with 194 illustrations, including 40 subjects in full color on 7 plates. Published by J. B. Lippincott Company, Philadelphia. Price $4.50.

UROLOGICAL SURGERY. By AUSTIN INGRAM DODSON, M.D., F.A.C.S., Richmond, Virginia, Professor of Urology, Medical College of Virginia; Urologist to the Hospital Division, Medical College of Virginia; Urologist to Crippled Children's Hospital; Urologist to St. Elizabeth's Hospital; Urologist to St. Luke's Hospital and McGuire Clinic. With Contributions by R. A. BERGER, M.D., F.A.C.R.; DOUGLAS G. CHAPMAN, M.D., F.A.C.P.; EVERETT IDRIS EVANS, Ph.D., M.D.; FRED M. HODGES, M.D., F.A.C.R., MAJOR GUY WINSTON HORSLEY; LINWOOD D. KEYSER, M.D., F.A.C.S.; LAWRENCE O. SNEAD, M.D., F.A.C.R. A volume of 768 pages, with 576 illustrations. Published by the C. V. Mosby Company, St. Louis. Price $10.00.

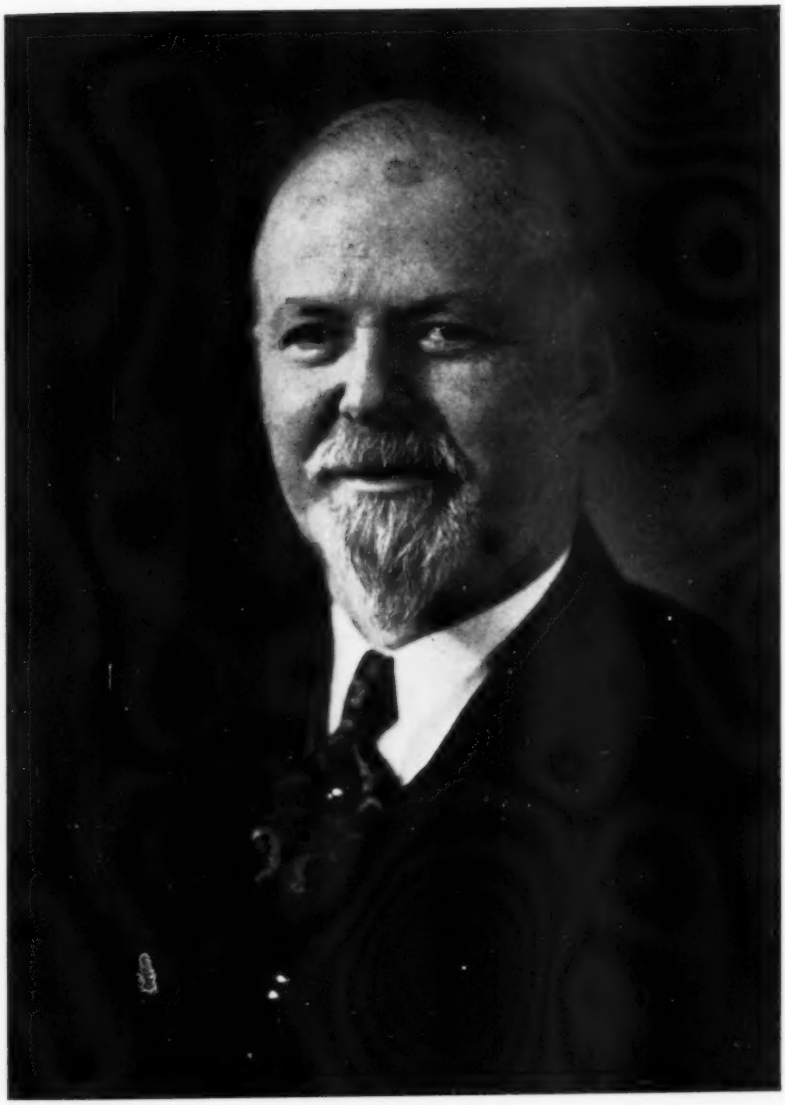
TECHNIC OF ELECTROTHERAPY AND ITS PHYSICAL AND PHYSIOLOGICAL BASIS. By STAFFORD L. OSBORNE, M.S., Ph.D., Assistant Professor, Department of Physical Therapy, Northwestern University Medical School, and HAROLD J. HOLMQUEST, B.S., B.S. (M.E.), Lecturer in Applied Physics, Department of Physical Therapy, Northwestern University Medical School, Chicago. A volume of 780 pages, with 240 figures (293 illustrations), 72 tables. Published by Charles C. Thomas, Springfield, Ill. Price $7.50.

EXPLORACIÓN RADIOLÓGICA DEL BRONQUIO. By S. DI RIENZO. Preface by RICHARD H. OVERHOLT, M.D. A volume of 340 pages, with 417 illustrations. Published by Sebastian de Amorrortu e Hijos, Córdoba 2028, Buenos Aires.

Book Review

This volume is a comprehensive treatise on bronchography and can be recommended as a helpful text for roentgenologists and surgeons who are interested in chest diseases. Even if they are not conversant with Spanish, they will find much of usefulness in the illustrations, which are of excellent quality.

The first three chapters deal with the embryology and anatomy of the bronchial tree, and contain numerous line drawings, photographs, and bronchograms which are of unusual clarity. A chapter is devoted to the instillation of iodized oil under fluoroscopic guidance and other chapters deal with the various chronic lung diseases which are amenable to this form of examination. The illustrations show complete filling of the bronchi in the various locations with an absence of overlapping shadows which attests to a painstaking technic on the part of the author that is to be highly commended.



ADOLPH HARTUNG, M.D.
1883-1944

IN MEMORIAM

ADOLPH HARTUNG, M.D.

1883–1944

Dr. Adolph Hartung, Professor of Radiology at the University of Illinois College of Medicine, died on May 29, 1944, of coronary stenosis. He had been ill for several months and had been confined to the hospital previously for short periods with a diagnosis of coronary disease but continued to work daily, with no word of complaint until the day before his death. His stoicism and continued cheerfulness caused even his close associates to hope that his condition was not serious.

Doctor Hartung was born on Feb. 26, 1883, in Gotha, Germany. He was brought to America at the age of fifteen months, the family settling in Milwaukee. There he attended grade school and the East Side High School, after which the family moved to Chicago.

In about 1900, Doctor Hartung became a demonstrator and salesman for the Scheidel X-ray Company with a territory extending from Michigan to Oklahoma. He demonstrated the new-found rays at the St. Louis Exposition in 1904. His interest in medicine stimulated, he entered the College of Physicians and Surgeons (later the University of Illinois) and was graduated in 1908. To meet the expenses of his education, he served as an apprentice in a pharmacy and later passed the examination for licensed pharmacist, though he had never attended a pharmacy class.

After a short period of general practice, Doctor Hartung decided to specialize in radiology and was successively radiologist to the Alexian Brothers, Grant, Cook County, and University of Illinois Research and Educational Hospitals. He served the latter institution from its inception in 1925. In 1909 he became associated with the University of Illinois College of Medicine as an instructor in the Division of Roentgenology of the Department of Medicine. He was made its first Professor of Radiology in 1925 and head of the department in 1927.

Doctor Hartung was a charter member of the Chicago Roentgen Society and served as president of that organization for two terms. He was also a Fellow of the American College of Radiology, a member of the American Roentgen Ray Society and of the Radiological Society of North America, and a diplomate of the Board of Radiology.

Conservative in diagnosis and therapy, he was an avid reader, ever alert for new methods or equipment. Commanding a wealth of clinical material, he limited his writing to what he considered worth-while contributions and despised what he called "re-hash" articles. A prodigious worker, Doctor Hartung lived with enthusiasm, his informal social manner belying his impressive professional appearance. He was granted the wish he often expressed and died "with his boots on."

T. J. WACHOWSKI, M.D.

H. KENNON DUNHAM, M.D.

1872–1944

After practising medicine for nearly fifty years, Dr. H. Kennon Dunham died in Cincinnati on April 27, 1944, from coronary thrombosis occurring in the course of convalescence from bronchial pneumonia. He served and inspired others to serve and left a lasting mark in the fields of his chosen endeavor.

Doctor Dunham was born in Fairview, Ohio, in 1872. He was graduated from the Miami Medical College, Cincinnati, in 1894, and did postgraduate work at Johns Hopkins (1896), at Great Ormond Street and St. George's Hospitals, London (1899), and at the University of Wisconsin (1915–17), where he was associated with Dr. Wm. Snow Miller and Dr. Henry Bunting. He early became interested in the application of x-rays to the diagnosis of intrathoracic lesions and subsequently limited his practice largely to the diagnosis and treatment of chest diseases, more particularly tuberculosis. He was Associate Professor of Medicine and head of the Department of Tuberculosis in the University of Cincinnati and from 1914 to 1940 was Medical Director of the Hamilton County Tuberculosis Hospital.

Doctor Dunham was President of the Cincinnati Academy of Medicine in 1921, President of the Ohio Public Health Association in 1930–32, and President of the National Tuberculosis Association in 1934–35. He was a diplomate of the Board of Radiology and of the Board of Internal Medicine, Fellow of the American College of Physicians and of the American College of Radiology, and a member of the American Clinical and Climatological Association, American Association of Thoracic Surgery, American Trudeau Society, American Roentgen Ray Society, and the Radiological Society of North America.

Doctor Dunham served in the First World War as Captain and Major and was active in the rehabilitation work of the Veterans Bureau. His son, Harry, was killed in the present war while on service in New Guinea.

H. KENNON DUNHAM, M.D.
1872–1944

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit 2, Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse 2, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago 11, Ill.

Section on Radiology, American Medical Association.—Secretary, U. V. Portmann, M.D., Cleveland Clinic, Cleveland 6, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary, J. S. Wilson M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Earl R. Miller, M.D., University of California Hospital, San Francisco, Calif.

Los Angeles County Medical Association, Radiological Section.—Secretary, Roy W. Johnson, M.D., 1407 South Hope St., Los Angeles. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Meets annually during meeting of California Medical Association.

San Diego Roentgen Society.—Secretary, Henry L. Jaffe, M.D., Naval Hospital, Balboa Park, Calif. Meets first Wednesday of each month.

San Francisco Radiological Society.—Secretary, Martha Mottram, M.D., Suite 1789, 450 Sutter St., San Francisco. Meets monthly on third Thursday at 7:45 P.M., in Toland Hall, University of California Hospital, from January to June; at Lane Hall, Stanford University Hospital, July to December.

COLORADO

Denver Radiological Club.—Secretary, A. Page Jackson, Jr., M.D., 304 Republic Bldg., Denver 2. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary, Max Climan, M.D., 242 Trumbull St., Hartford 3. Meetings bimonthly, second Thursday.

FLORIDA

Florida Radiological Society.—Secretary-Treasurer, Charles M. Gray, 306 Citizens Bldg., Tampa 2.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta 3. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 7144 Jeffery Ave., Chicago 49. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago 12.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis 7. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St., Baltimore 1. Meets third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit 1. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, A. J. Stenstrom, M.D., Minneapolis General Hospital, Minneapolis 26. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, E. W. Spinzig, M.D., 2646 Potomac St. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha 2. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary-Treasurer,* George Levene, M.D., Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.,—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave., Brooklyn 26. Meets fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday evening each month. October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse 10. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Ramsay Spillman, M.D., 115 E. 61st St., New York 21, N. Y.

Rochester Roentgen-ray Society.—Secretary, Murray P. George, M.D., 260 Crittenden Blvd., Rochester 7. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., 707 Race St., Cincinnati 2. Next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Samuel Brown, M.D., 707 Race St., Cincinnati 2. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport 8. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia 4. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh 24, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary,* A. M. Popma, M.D., 220 North First St. Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond 19.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee 3. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison 6, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

La Société Canadienne-Française d'Electrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiologia y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Note on the First Demonstration of an Intracranial Foreign Body by Roentgen Rays. Cobb Pilcher. J. Nerv. & Ment. Dis. **99:** 71–73, January 1944.

The author records an interesting incident in early American radiologic history, giving credit for the first radiograph for an intracranial foreign body to Dr. Wm. Stubenbord. The examination was performed before the Brooklyn Medical Society on June 19, 1896, with use of a Crookes tube and a galvanofaradic machine. The plate was immediately developed and presented to the Society. An illustration shows the bullet shadow in the orbit. An account of the case was published in the Brooklyn Medical Journal (**10:** 737, December 1896). LESTER M. J. FREEDMAN, M.D.

THE CHEST

A Comparative Study of Chest X-Ray Survey Methods. Arthur B. Robins. U. S. Nav. M. Bull. **41:** 1036–1040, July 1943.

The author conducted a comparative study of mass chest x-ray survey methods as applied to the examination of large numbers of civil employees in a navy yard. Factors considered were accuracy, expense, time required, and convenience. Fluoroscopy was discarded as being time-consuming to the operator and subject and failing to produce a permanent record. As no commercial contract service was available using 4 × 5-inch photofluorography, this method was also eliminated. The choice thus fell between roll paper film and 35-mm. fluorography.

Sixty selected subjects were examined by both methods, with additional full-sized celluloid films. Four radiologists were given the films for interpretation, the celluloid films being assessed last. All abnormalities were noted on the records, and no comparison between the different types of films was made until the entire reading was completed. Each physician's own interpretation of the 14 × 17-inch celluloid film was used as his basis for comparison. Only parenchymal lesions such as reinfection tuberculosis, calcified primary tuberculosis, or pneumoconiosis were considered in the scoring. A lesion was considered missed if it was described on the celluloid film but not identified on either or both of the survey films, or if it was described on one side in the survey film and both sides in the 14 × 17-inch celluloid film.

On the 35-mm. film, 20.9 per cent of the lesions were missed, while on the paper film only 1.2 per cent were missed. On 7.1 per cent of the photofluorograms and 3.3 per cent of the paper films, lesions were described which were not confirmed on the corresponding celluloid films. As overreading necessitates re-examination with consequent loss of production time, the latter figure is deemed significant.

ELLWOOD W. GODFREY, M.D.

X-Ray Diagnosis of the Non-Tuberculous Chest. Francis L. Simonds. Nebraska M. J. **29:** 4–8, January 1944.

The author stresses the value of the roentgen examination and its proper interpretation in the diagnosis of diseases of the chest. He describes his method of study of a flat roentgen film in which each lung field is arbitrarily divided into three vertical zones: an inner, middle, and peripheral zone. The inner zone contains the root or hilum shadows. The middle zone contains the trunk shadows, gradually fading out into their final subdivisions. The peripheral zone contains radiating lines or linear markings and the parenchyma. These linear markings are the ultimate trunk shadows, and they gradually fade away in their final divisions before the periphery is reached.

Diseases of the chest are divided into four major groups: infections, tumors, circulatory disorders, and irritations. The roentgen appearances of several lesions are described and illustrated.

HENRY K. TAYLOR, M.D.

Non-Tuberculous Pulmonary Cavitation. Louis Nathanson and Philip Morgenstern. Am. J. Roentgenol. **51:** 44–52, January 1944.

In an analysis of 2,000 autopsies at Sea View Hospital, New York, on patients with cavitary lesions in the lungs, involving all lobes, Auerbach (personal communication to the authors) found approximately 1.5 per cent with non-tuberculous cavities. The percentage must be higher in non-tuberculous or general hospital autopsy material.

A series of case histories is presented illustrating some of the lesions which produce cavitation and simulate a cavitating tuberculous process. X-ray cavities in silicosis may be produced by emphysematous blebs, lung abscesses, or necrosis of silicotic areas. Cavitation in silicosis does not always indicate silicotuberculosis. A case of cystic bronchiectasis with one large cyst and numerous smaller cavities of the right lung is described. Pneumonectomy was performed on this patient. A case of actinomycosis of the lungs is presented in which patchy infiltration with several highlights suggesting cavitation were seen. Autopsy revealed multiple actinomycotic abscesses.

In another patient a large saccular aneurysm of the descending thoracic aorta had invaded the left lower lobe and produced a large cavity. There was no tuberculous involvement of either lung. Bronchiogenic adenocarcinoma was proved to be the cause of cavitation in another instance. A chronic pyogenic abscess in an upper lobe may occur. Repeatedly negative sputum examinations will prove decisive in differentiation from a tuberculous cavity. Bronchiectasis involving the upper lobes is indistinguishable clinically from chronic pulmonary tuberculosis. The absolute limitation of the process to one lung is of the greatest importance in differentiating these lesions. Fibroid tuberculosis usually will show some infiltration in the opposite lung (Wessler and Jaches: Clinical Roentgenology of Diseases of the Chest, Troy, N. Y., Southworth Co., 1923).

Winn (Arch. Int. Med. **68:** 1179, 1941) has recently reported 12 cases of pulmonary cavitation associated with coccidioidal infection. Occasionally a gumma may cavitate centrally and simulate tuberculosis. In children one may find cysts or bleb formation in association with pneumonias, suggesting a tuberculous lesion. CLARENCE E. WEAVER, M.D.

Lower Lobe Bronchiectasis Associated with Tuberculosis. E. B. Mitchell and T. F. Thornton. Am. Rev. Tuberc. **49:** 38–47, January 1944.

It has been generally accepted that bronchiectasis limited to the lower lobe is non-tuberculous. The authors report five cases in which lower lobe bronchiectasis was found to be associated with tuberculosis. These cases represent about 5 per cent of the cases of bronchiectasis seen in the University of Chicago clinics during the last ten years. The diagnosis of tuberculous bronchiectasis involving a lower lobe is not easily made, probably because it is not often suspected. In two of the five patients examination of the sputum showed tubercle bacilli and there were histories of recent tuberculosis. The features that lead to a suspicion of tuberculosis are: (1) suggestive history; (2) roentgenological evidence of apical tuberculosis; (3) bronchoscopic finding of bronchial stenosis; (4) unilateral or unilobar bronchiectasis. The diagnosis can be made with certainty only if a positive sputum is obtained, and careful sputum examination should be stressed in all cases of bronchiectasis. The main etiologic factor appears to be a tuberculous bronchitis with stenosis. The knowledge that tuberculosis is present in a case of lower lobe bronchiectasis is of importance when surgical resection is considered. Surgical intervention should not be undertaken without regard for the added risk of lobectomy in the presence of active tuberculosis but is indicated when the symptoms of bronchiectasis are sufficiently severe and no active tuberculosis is present elsewhere in the lung.

L. W. PAUL, M.D.

Postoperative Pulmonary Collapse in Childhood. Clement J. Molony. Am. J. Dis. Child. **66:** 280–301, September 1943.

Twenty-one cases of postoperative atelectasis taken from the records of the Children's Memorial Hospital in Chicago and the Los Angeles Children's Hospital, for the ten year period 1931 to 1941, are presented. As the author points out, there is a much lower incidence of postoperative collapse in a children's hospital than in a hospital for adults, since surgical intervention in the upper part of the abdomen is less frequent in childhood and because children are not kept so immobilized and narcotized as adults.

The diagnosis of postoperative atelectasis is based on the rather sudden onset of cough, fever, and dyspnea in a child who has been operated on a day or so earlier. There are suppression of breath sounds, dullness, and usually rales and signs of consolidation over the involved area of the lung. The roentgenogram shows a shadow corresponding to a collapsed lobe or to collapsed lobes; the leaf of the diaphragm is high on the involved side, and usually the heart is shifted toward the side of the collapse. Collapse of the upper lobe may or may not pull the heart toward the lesion.

The etiologic factors for collapse following surgical procedures are discussed, and precautions against and treatment for postoperative atelectasis are suggested. The main objective of treatment is to help the patient cough out the secretions. This is best done by change of position. Potassium iodide or ammonium chloride may be given to liquefy the secretions. In cases in which such measures are ineffective, bronchoscopic drainage should be instituted without too great delay. Even in properly treated cases bronchiectasis may develop. Brief histories of the 21 cases are included.

Primary Atypical Pneumonia. An Analysis of Therapeutic Results in 155 Cases. Howard L. Correll and Irving I. Cowan. U. S. Nav. M. Bull. **41:** 980–987, July 1943.

The authors report their clinical experiences and therapeutic results in 155 unselected cases of atypical pneumonia. The month to month incidence did not fluctuate with the incidence of upper respiratory infections and showed no significant seasonal variation. Radiographic findings were generally more advanced than the physical signs. The pneumonia was confined to one or both lower lobes in 92.8 per cent and involved the upper lobe or 3 lobes in the remainder. Migration or extension of the pneumonic process was observed in 12.6 per cent of the patients who were followed by serial x-rays, while resolution was delayed beyond thirty days in 14.5 per cent of the same group.

Seventy-two patients were treated by routine methods; 41 were given sulfathiazole and 10 sulfanilamide; 23 received x-ray therapy consisting of 112 roentgens measured in air (100 kv., 5 ma., 25 cm. target-skin distance, 2 mm. aluminum added filtration, with a half-value layer of 3.6 mm. of aluminum) to the involved area. This dose was repeated in twenty-four hours if the clinical response was not satisfactory. Those treated routinely ran a fever for an average of 6.8 days and required an average of 23.4 days for clearing as demonstrated by x-ray films. The patients treated with sulfathiazole ran a fever for an average of 6.5 days and required an average of 21.2 days for clearing, while those treated with sulfanilamide ran a fever for an average of 6.4 days and required 20.0 days to clear. The acute cases treated with irradiation ran a fever for an average of 3.8 days only and required an average of 8.3 days to show clearing roentgenographically. Nine patients with unresolved pneumonia who had been ill for an average of 33.3 days received similar x-ray therapy. Subsequent to this therapy the lesions showed radiographic evidence of resolution in an average of 4.0 days.

ELLWOOD W. GODFREY, M.D.

Roentgenological Types of Pulmonary Lesions in Primary Coccidioidomycosis. Justin R. Colburn. Am. J. Roentgenol. **51:** 1–8, January 1944.

Coccidioidomycosis is caused by inhalation of dust-borne chlamydospores of the fungus in its vegetative stage. The symptoms usually consist of dry cough, chest pain, malaise, fever, weight loss, and night sweats. Five to 20 per cent of the patients may develop erythema nodosum or multiforme. Gradual recovery is the rule. Resolution of the pulmonary lesions is often prolonged weeks after the patient is clinically well. In an extremely small percentage of cases the highly fatal chronic disseminated granuloma stage develops, apparently as endogenous "reinfection."

The author's material consisted of 75 soldiers admitted to the Station Hospital, Camp San Luis Obispo, California, during the favorable dry, dusty season. In 29 or 38.7 per cent of these cases infiltrative fan-shaped densities were observed roentgenographically, extending from prominent hilar shadows. This picture resembles bronchopneumonic inflammation with a minimum of consolidation. Resolution is slow, averaging forty days. Hilar densities without evidence of significant peripheral bronchial or parenchymal involvement were observed in 24 per cent of the group studied. Peripheral lobular and sublobular exudates

and infiltrates were found in 26.6 per cent. When the upper lobes were affected, the lesions resembled minimal "reinfection" tuberculosis. Demonstrable cavitation occurred in 3 cases (4 per cent). Two of these healed; the third one persisted as a cyst-like excavation. Two patients had massive pleural effusion without evidence of parenchymal infiltration.

Production of a variety of pulmonary lesions by *Oidium coccidioides* is well explained by the possible state of balance of three important factors: individual resistance, dosage of the infecting organism, and allergic status of the host. A fourth factor may be time, or the intervals between succeeding repeated infecting doses in relation to ascending allergy of pulmonary tissues. Indications of a predominantly proliferative reaction with a minimum of fibrosis are found in the characteristic course of the disease. Permanent fibrotic residues are not conspicuous. Calcification of healed caseated tracheobronchial lymph nodes has been observed. Inconclusive roentgenographic evidence was considered to be present in only 3 cases of this series.

The most constant roentgen finding is hilar shadow confluency, widening and increased radiopacity. The most valuable diagnostic roentgen criterion is delayed but fairly complete resolution, placing the disease midway between "acute" and "chronic" in the scale of pulmonary inflammations.

CLARENCE E. WEAVER, M.D.

Bagassosis: A Case Report. S. Chaille Jamison, Margaret Strange Bryan, and Jane Matthews Day. New Orleans M. & S. J. **96:** 291–294, January 1944.

A 32-year-old negro gave an occupational history of eight months' exposure to sugar cane grindings. The occupational period was divided into two periods: (1) seven months of exposure to damp cane grindings, followed by (2) one month of exposure to dry bagasse. Symptoms—cough, weakness, malaise, dyspnea—developed only after exposure to the dry dust. A roentgen examination of the chest revealed a diffuse miliary type of infiltration throughout both lung fields with enlarged hilar lymph nodes. Follow-up roentgenograms showed progressive but not complete resolution of the lesion during a five-month period. Clinical symptoms disappeared in less than four weeks following cessation of exposure to bagasse dust.

HENRY K. TAYLOR, M.D.

Etiology of Erythema Nodosum. Peter Kerley. Brit. J. Radiol. **16:** 199–204, July 1943.

The most widely held theory of the etiology of erythema nodosum is that it is an allergic reaction to bacterial and chemical toxins. Many believe it to be a manifestation of tuberculosis. Against these theories are the facts that it is largely confined to the Nordic races, that it has a seasonal incidence, that it occurs in small epidemics in schools, barracks, and factories, and that it is limited to certain age groups—chiefly two to ten and eighteen to thirty years. The pulmonary lesions and the lesions at the hilum seen by x-ray do not resemble tuberculosis. The rapid appearance and disappearance of the lesions is also inconsistent with that disease.

The behavior and appearance of the lesions of erythema nodosum as observed in the author's series of 37 cases—all in adults—resemble the known behavior and appearance of sarcoidosis. The radiological findings are identical. In 2 cases, skin lesions excised after the acute rash had disappeared showed the histologic characteristics of sarcoids. In 2 others, eye lesions strongly suggestive of sarcoidosis developed. The history of fatigue as the sole symptom in association with extensive visceral changes is also typical of sarcoidosis, as is the absence of physical signs with massive bronchial node enlargement. Absence of splenic enlargement and changes in the phalanges in the series reported are against sarcoidosis, but not all cases of the latter disease show these changes, and they may be present without radiologic evidence.

The author hesitates to draw definite conclusions on the basis of 37 cases, but he does believe that the evidence presented indicates that those patients with erythema nodosum with obvious visceral manifestations are suffering from sarcoidosis. Erythema nodosum may, indeed, be two diseases, distinguished by the presence or absence of such manifestations.

SYDNEY J. HAWLEY, M.D.

Laminagraphic Studies of the Aorta: Their Advantages and Limitations. Wendell G. Scott and Donald S. Bottom. Am. J. Roentgenol. **51:** 18–28, January 1944.

The laminagraph of Kieffer and Moore was used by the authors in their studies of the aorta. It is well suited for the examination because, by employment of the spiral movement, all the unwanted shadows are blurred out. The left anterior oblique position is used for demonstrating the ascending portion of the arch of the aorta. The laminagram is usually made at a level opposite the right anterior axillary line. For showing the descending portion of the arch of the aorta and the descending thoracic aorta, the left lateral position is used. These laminagrams are made at levels 2 to 4 cm. lateral to the spinous processes. Conventional roentgenograms, made first, indicate the most advantageous level in a given case.

In children and young adults, sectional roentgenography is not of much advantage. In patients fifty years of age and older, arteriosclerotic changes have developed to various degrees and sectional roentgenography is of value. The aortic wall is more dense and there is a marked spread in the distance between the ascending and descending aorta.

An important but seldom recognized complication of advanced arteriosclerosis of the aorta is the development of a dissecting aneurysm. In this condition there is usually a sudden onset of severe pain in the middle of the thoracic back, upper lumbar spine, and left chest. Lateral sectional roentgenograms will show a marked increase in the width of the aortic arch and the proximal descending thoracic aorta. Three such cases are described, with reproductions of the roentgenograms showing the enlarged aortic shadows. These could not be properly demonstrated on conventional roentgenograms.

Sectional roentgenography can be employed with equal effectiveness in visualizing sacculated thoracic aortic aneurysms. It also has occasionally been helpful in distinguishing between aneurysms and mediastinal tumors.

The main advantages of body section roentgenography of the aorta are that the examination is simple and can be done by a technician, and it is not uncomfortable or hazardous to the patient.

CLARENCE E. WEAVER, M.D.

Pneumohydropericardium. Report of Three Cases. Richard A. Kern and Ellwood W. Godfrey. U. S. Nav. M. Bull. **41:** 1001–1011, July 1943.

The authors report 3 cases of pneumohydropericardium occurring in a series of 75 cases of traumatic pneumohydrothorax. In all three instances the air and fluid in the pericardial sac were believed to have gained access through a pericardial tear resulting from a sudden and violent shift of the mediastinum.

The diagnosis and treatment are briefly discussed. The authors point out that the physical signs and roentgenologic findings of pneumohydropericardium are dependent upon two factors: (*a*) the presence or absence of adhesions that might determine the location and the mobility of air and fluid in the pericardial sac; (*b*) the relative amounts of air and fluid present. The more air and the less fluid, the greater the likelihood that a mill-wheel murmur be heard and that excessive motion of the heart shadow be seen fluoroscopically. ELLWOOD W. GODFREY

THE DIGESTIVE SYSTEM

Effect of Motion on the Roentgenographic Appearance of the Stomach and Small Bowel. Francis E. McDonough and Martin Schneider. Gastroenterology **2:** 32–45, January 1944.

One hundred healthy males between the ages of 19 and 35 were tested by roentgenographic studies for susceptibility to motion sickness. Before testing, each subject drank 2 oz. of barium sulfate suspended in 250 c.c. of water. No attempt was made to regulate the time of testing in relation to food or fluid intake. Observations were made by fluoroscopy in 19 and by roentgenograms in 81 cases. The fluoroscopic observations were made while the subject drank the test meal and continued long enough to enable the fluoroscopist to record the size, shape, position, tone, peristaltic activity, evidence of pylorospasm, and beginning emptying of the stomach. The subject then underwent testing on the motion-producing device. At the completion of the motion test, he returned to the fluoroscopic room and the changes from the pre-motion appearance of the stomach, as well as the appearance of the small intestine, were noted. In the roentgenographic studies the same sequence was maintained.

Twenty-eight of the 100 subjects were classified as having become "sick" and 72 as "immune," *i.e.*, without signs or symptoms of motion sickness. Eleven of the 72 well subjects and 5 of the 28 "sick" subjects showed poor gastric tone before testing, indicating that this does not predispose to motion sickness. Gastric peristalsis was present before testing in 54 of the "immune" subjects and 22 of the "sick" subjects. After testing, only 12 of the "immune" subjects (16.6 per cent) showed a decrease in peristalsis as compared with 16 (57 per cent) of the "sick" subjects. Forty-eight of the "immune" and 11 of the "sick" subjects showed no change with testing in either gastric tone or peristalsis. Thirteen (46.4 per cent) of the 28 "sick" subjects as compared with 6 (8.3 per cent) of the 72 "immune" subjects showed a decrease in both gastric tone and peristalsis, *i.e.*, over 5 times as large a proportion of "sick" subjects as of "immune" subjects, a highly significant difference. Of the "immune" subjects 27.8 per cent and of the "sick" 21.4 per cent had pylorospasm before testing; the corresponding figures after testing were 31.9 per cent and 42.8 per cent, which indicates that changes in the occurrence of pylorospasm bear no relationship to the occurrence of "sickness."

No significant difference in the type of change of intestinal progress of the barium meal was observed in the two groups.

In 47 of the 100 subjects very little or no barium appeared in the duodenum or proximal jejunum after testing, although barium was present in the stomach, distal jejunum, and ileum. The authors term this condition the "interval pattern" and found no apparent relationship between its occurrence and "sickness" and "immunity." It apparently occurs secondary to motion and can be called an effect of motion, but the mechanism is unknown.

The authors conclude that there is no specific type of gastro-intestinal tract, either from an anatomic or functional standpoint, which is associated with motion sickness susceptibility.

Life Cycle of Carcinoma of the Stomach. Report of Three Interesting Cases of Carcinoma of the Pylorus. Maurice Feldman. Gastroenterology **2:** 60–64, January 1944.

Three closely parallel cases, illustrating the life cycle of carcinoma of the stomach, are presented. Repeated roentgen examinations were made in each case, over a number of years, enabling the author to study the sequence and progress of the growth from the onset to its final stage. The clinical picture was that of peptic ulceration with periods of remission. The roentgen findings were similar in all three instances—narrowing of the prepylorus involving both curvatures, fixation of the curvatures, with a plateau appearance of the lesser curvature in the affected area. Growth was slow, extending over many years. Two of the patients had persistent low gastric acidity, while one showed a hyperacidity throughout the entire course of the illness. In each case there finally developed a pyloric obstruction due to an inoperable carcinoma.

Negative roentgen findings on gastric examination often give a sense of false security. The demonstration of a narrowing of the pylorus suggests a possible lesion. In spite of a negative gastro-intestinal study, an organic lesion somewhere in the alimentary tract should be suspected in a patient with a digestive disorder who is clinically getting worse or is not improving. Under these circumstances repeated interval roentgen studies are indicated.

A series of roentgenograms illustrates each case report.

Hypertrophic Pyloric Stenosis in Adults. J. Edward Berk and Harold J. Dunlap. Ann. Surg. **119:** 124–133, January 1944.

Some hundred odd cases of simple pyloric muscle hypertrophy in adults have been reported in the literature and there are, no doubt, numerous unrecorded examples. The authors present two additional cases, in each of which a psychogenic factor may have played a role.

One patient was aged thirty-seven and the other thirty-nine. Both were males and had been inducted into the Army several months before reporting to the hospital for examination. Both showed evidence of personality dysfunction and both had experienced serious domestic and financial problems in civil life.

Each gave an "ulcer-like history occurring in conjunction with symptoms and signs of partial to complete pyloric obstruction," and in each a roentgenogram showed the narrowing of the antrum and pylorus, with intact mucosa, and invagination of the base of the duodenal cap that have been described as characteristic of pyloric muscle hypertrophy. In each case a subtotal gastrectomy was done. Histopathologic study showed, in addition to the hypertrophy of the pyloric muscle, an associated gastritis, though preoperative gastroscopy had revealed no mucosal abnormalities.

The authors believe that in cases such as theirs complete reliance for diagnosis on the operative findings alone is a practice fraught with danger. The inability to exclude a malignant growth in these cases justifies gastric resection rather than a simple palliative procedure even though one may strongly suspect that the mass is composed only of hypertrophied muscle.

G. A. CREEL, M.D.

Congenital Atresia of the Duodenum and of the Ileum: Report of Two Cases with Successful Results Following Operation. Edwin M. Miller, Joseph Greengard, William B. Raycraft, and Irma McFadden. Am. J. Dis. Child. **66:** 272–279, September 1943.

A successful outcome in a case of congenital atresia of the ileum, as in congenital obstruction of the duodenum, demands early diagnosis and prompt surgical intervention. The prospects in obstruction of the ileum are less favorable, however, than in duodenal atresia. Left alone for more than two or three days, the rapidly distending, completely obstructed small bowel undergoes progressive degenerative changes leading to necrosis, and too often operation is delayed to the point where actual peritonitis has already set in.

Vomiting, beginning immediately after birth, is the outstanding symptom of obstruction of either the duodenum or the ileum. When the obstruction is in the ileum, the vomitus is at first composed of stomach contents, then is stained with bile and rapidly becomes brown and has a fetid odor. If it remains constantly biliary, it is quite likely due to obstruction of the duodenum. The lower part of the abdomen is relatively flat with duodenal atresia, but with atresia of the ileum becomes progressively distended and yields a tympanitic note on percussion. Roentgen findings are of the greatest importance. A plain film will show clearly the distended stomach and duodenum or the several loops of distended small bowel. Practically no air can be visualized in the colon. If a barium enema is given, the collapsed state of the entire large bowel can be easily made out.

Two cases of congenital atresia of the ileum, in which successful operations were performed, are reported, with details of the surgical technic.

Roentgen Study of Lymphogranuloma Venereum: Report of Twenty-Four Cases. I. Klein. Am. J. Roentgenol. **51:** 70–75, January 1944.

Lymphogranuloma venereum appears first in males as a minute erosion or papule on the penis or prepuce; in females the infection is carried not to the inguinal nodes but to the wall of the rectum. Symptoms of rectal and colonic involvement are tenesmus, constipation, and mucous and bloody stools. The disease is chronic, sometimes running a course of twenty years or more. Roentgen studies show a destruction of the mucosa, rectal strictures, distention of the rectal pouch, single and multiple perirectal and perisigmoid sinus formation, and fistulous tracts. Roentgenograms are furnished, showing tubular narrowing of the rectum, extensive rectosigmoid narrowing with perianal sinuses, annular stricture of the rectosigmoid simulating cancer, and extensive narrowing involving the rectum, sigmoid, and descending colon.

Lymphogranuloma venereum is occasionally mistaken for cancer. Cancer, however, is of shorter duration. Lesions of lymphogranuloma venereum begin in the anal region, while cancer tends to develop in the rectum. Cancer, on roentgen examination, shows an irregular shadow protruding into the lumen. Lymphogranuloma venereum shows more often a regular shadow. In cancer, the rectum below the stricture, down to the anus, will show normal mucosal folds. This will not be the case in lymphogranuloma venereum. A sinus tract is common in lymphogranuloma venereum and is unusual in cancer.

Ten of the author's series of 24 cases were in males, all of whom had inguinal scars or palpable nodes. Seventeen of the 24 patients were Negroes.

On account of certain characteristics which can be shown definitely by roentgen examination, it seems advantageous to use the x-ray as an aid in establishing the diagnosis and extent of this disease.

CLARENCE E. WEAVER, M.D.

Cholecystography and Jaundice. Frank Huber. Am. J. Roentgenol. **51:** 12–17, January 1944.

The experience of various observers with cholecystography in the presence of jaundice is reviewed. The author's report is based on the findings in 50 unselected cases of jaundice which were submitted to cholecystography by the intensified oral method. No deleterious effects due to the procedure were noted. Eleven out of 15 cases with common duct stone showed "no shadow" of the gallbladder; faint gallbladder shadows were seen in 4 cases. Two of 3 cases of cholecystitis without cholelithiasis showed faint shadows. The second largest group (11 cases) had no final diagnosis; a very faint shadow was obtained in a single instance, while the other 10 cases showed no shadow. In 10 cases of toxic and infectious hepatitis good shadows were obtained in 7 and faint shadows in 3 cases. In 3 cases of cancer of the common duct a faint shadow appeared in 1, no shadow in 2.

In cases in which jaundice is decreasing, a patent common duct is predicated and the same diagnostic criteria are used as in patients without jaundice. In these cases cholecystography may well be deferred. With increasing jaundice, diagnostic information is usually not obtained, since apparently no difference exists in the degree of impairment of dye excretion whether due to back pressure (extrahepatic biliary obstruction) or to parenchymatous disease, either toxic, infectious, cirrhotic, or neoplastic.

CLARENCE E. WEAVER, M.D.

Emphysematous Cholecystitis. C. A. Stevenson. Am. J. Roentgenol. **51:** 53–60, January 1944.

Emphysematous cholecystitis may be defined as an acute infection of the gallbladder characterized by gas production in the lumen and walls and the pericholecystic tissues. Any virulent gas-producing organism may produce the disease when favorable circumstances exist. Roentgenographic demonstration of this condition is rare.

Of the various microorganisms which have been found in the gallbladder and its walls, *B. welchii* is the one most likely to produce gas under anaerobic conditions. The most probable sequence of events in the production of the disease is lodging of a stone in the cystic duct, with resulting decrease in the local resistance of the gallbladder tissues, allowing avirulent *B. welchii* to become virulent, followed by production of gas in the gallbladder, emphysematous blebs in the loose areolar tissue of the gallbladder wall, and extension of the infection to the pericholecystic tissues.

Three cases are reviewed. These gave roentgenographic evidence of gas in the gallbladder lumen, emphysematous blebs in the wall, and collections of gas in the pericholecystic tissues. Two of the patients were operated upon and recovered. No intensive effort to demonstrate *B. welchii* was made. The third case was treated with sulfathiazole, B. welchii antiserum, and roentgen therapy. This patient also recovered.

The presence of gas in the gallbladder lumen alone is not sufficient for the diagnosis of emphysematous cholecystitis, for patients with biliary fistulae commonly show gas in the gallbladder, either with or without gas in the biliary duct system.

CLARENCE E. WEAVER, M.D.

Diaphragmatic Hernia. J. Edmund Bradley and D. James Greiner. Am. J. Dis. Child. **66:** 143–149, August 1943.

A case is reported of the rare type of true congenital diaphragmatic hernia on the right side with a portion of the liver as the only content of the hernial sac.

The patient, a white boy, appeared normal at birth, but at the end of the second week it was noticed that his respiration seemed unusually rapid. He was first seen by the authors at the age of seven weeks. At this time the respiratory rate was greatly accelerated, with a pronounced retraction of the interspaces with each respiration. There was a definite bulging of the right anterior portion of the chest wall. The nail beds of the fingers and toes appeared slightly cyanotic. The trachea was deviated to the left. The heart was percussible to the left anterior axillary line. Heart sounds were normal. There was a pronounced impairment of the normal resonance in the right anterior portion of the chest, with hyperresonance on the left. The breath sounds throughout the right side of the chest anteriorly were extremely distant, and numerous crepitant and subcrepitant râles were heard. Posteriorly the breath sounds were absent.

Roentgen examination showed the heart and great vessels to be pushed to the left and an area of increased density in the right lung extending from the fourth rib to the diaphragm and from the hilus to the outer zone of the lung. The impression was that this area represented a fluid-containing cyst or tumor of the lung. An exploratory tap was done and air alone obtained. Because of the age of the patient, operative intervention was postponed.

Roentgen examinations at approximately monthly intervals revealed no change from the condition shown on the original roentgenogram. The child gained weight and seemed to experience no particular distress. At the age of five and a half months, on Jan. 2, 1941, the patient was admitted to the hospital for operation, but before this was attempted, a lobar pneumonia developed in the upper lobe of the left lung. The immediate response to sulfapyridine therapy was good but several days later an upper respiratory tract infection occurred, followed by a disseminated pneumonia. Death ensued Feb. 16, 1941.

Autopsy revealed bronchopneumonia of the left lung. The right lung showed only rudimentary development and was adherent to and compressed by a rounded solid mass which rendered it completely atelectatic. This mass consisted of a portion of the right lobe of the liver and the gallbladder covered by a thin fibrous membrane which could be reflected in a glove-like manner after the diaphragm had been freed. The membrane was a defective portion of the diaphragm which formed a hernial sac with an opening measuring 4 cm. in diameter.

Survey Film Diagnosis of Acute Surgical Abdomen. Samuel Levine and Leon Solis-Cohen. Surg., Gynec. & Obst. **78:** 76–82, January 1944.

The authors review the advantages of survey films of the abdomen in most of the common and in many of the unusual surgical conditions, including intestinal obstruction, ruptured viscera, tumors and abscesses causing mass effects, thrombosis, trauma, and ruptured aneurysm. Films are described as much more accurate than fluoroscopy, and various postures and projections must be used to secure the most information. Thus, in the presence of free fluid or air in the peritoneal sac, not only the supine but also the upright or lateral decubitus exposures must be made to demonstrate air and fluid levels. Another item worthy of attention is that positive findings increase in many of the cases of ruptured viscus as the interval between rupture and examination increases, thus demonstrating the necessity for repeated studies.

The statement that free air beneath the right leaf of the diaphragm is pathognomonic of a ruptured hollow viscus must be modified when it is recalled that some rare exceptions to this occur in abscesses produced by gas-forming bacteria. The authors urge the inclusion of observation of the diaphragm and of the lower chest as an aid to diagnosis of the abdominal state.

Among the more interesting conditions described is splenic rupture, creating displacement of the stomach and colon, and showing roentgenographically a serrated outline of the greater curvature of the stomach and marked gastric dilatation. Of interest, also, is an instance of obstruction with gastrectasia in a case of tuberculous adenitis of the retroperitoneal nodes near the duodenum.

EDWIN L. LAME, M.D.

THE SKELETAL SYSTEM

Growth of Major Long Bones in Healthy Children: A Preliminary Report on Successive Roentgenograms of the Extremities from Early Infancy to Twelve Years of Age. Marion M. Maresh. Am. J. Dis. Child. **66:** 227–257, September 1943.

Serial roentgenograms of the left arm and leg were taken on a group of 113 healthy children, 52 girls and 61 boys, at semiyearly intervals up to twelve years of age. Six hundred and seventy-one sets of these form the basis of this study. The lengths of the humerus, radius, ulna, femur, tibia, and fibula obtained from these roentgenograms were used, without correction for distortion, in the study of rates of growth of these bones

and of correlations between the lengths of the bones and skeletal growth.

The roentgenographic technic was kept as constant as possible with children of such different ages. A 7 1/2-foot (228.6 cm.) focus-film distance was used throughout to reduce the distortion to a minimum. High-speed screens were employed, with the result that some of the finer details of bone structure were sacrificed in the interest of speed. Infants were held in position with the arm or leg flat against the cassette in an anteroposterior position, while the older children stood on a platform with the arm or leg in contact with the surface of the cassette. Exposures were made with 100 ma. and as short a time as was feasible. For infants one-twentieth of a second and 65 to 75 kv. were found to be adequate. For older children, time and voltage varied from one-tenth to nine-twentieths of a second and from 60 to 75 kv.

The measurements were made in the simplest possible manner, the greatest possible length of the shaft being taken along the long axis of the bone from epiphyseal line to epiphyseal line. All measurements were made and checked by the same person.

The author does not attempt to draw any certain or far reaching conclusions from this preliminary study but presents the method as a reliable technic in the study of growth. Numerous tables and charts are included showing the different types of growth curves, the ratio of length of each long bone to total body stature, etc. Increase in length of the bones on successive measurements indicates that the growth rate, at least up to the age of ten years, is remarkably orderly. Some sex differences are suggested. An approximate straight relationship between the length of one bone and that of another was found, with high coefficients of correlation. High correlation coefficients were also found between stature and lengths of the bones. An essential straight line relationship between these measurements exists after approximately six months of age, but prior to that time, lengths of the bones are proportionately greater in relation to stature than they are at later ages. Thus, in the early postnatal months it is probable that the trunk is growing in length at a faster rate than the rest of the axial skeleton.

X-Ray Appearances of Bone in Yaws. Carl H. Goldmann and Stephen J. Smith. Brit. J. Radiol. **16:** 234–238, August 1943.

Yaws is of radiologic interest chiefly in the tertiary stage, which is the stage in which skeletal involvement occurs. The observations presented here are based upon 101 cases (selected from 185) in which the diagnosis was established beyond clinical doubt.

Yaws (and by yaws the authors mean tertiary yaws) affects chiefly the extremities in the following order of frequency: tibia, fibula, femur, and ulna. During the active stage of the disease, as early as four weeks after the appearance of clinical symptoms, small oval islands of destruction appear in the compact bone. The periosteum is not affected until there is some destruction in the adjacent cortex.

Untreated, the disease gradually progresses into the inactive stage. The bone thickens, mainly at the expense of the marrow space. The compact bone loses calcium, and streaks of decalcification like fibrils are visible on the inner and outer borders. The bone may remain this way for many years. In some instances the changes progress to resemble "marble bones" and the bone becomes abnormally brittle. Bowing occurs and fractures are common. Much the same changes occur in treated cases but development into an inactive stage is hastened.

The patient with yaws of the spine presents the clinical picture of an infectious spondylitis. Radiographically the bone is eburnated. There may or may not be round central areas of destruction like gummata within the compact areas. Bony bridges are common.

The differential diagnosis from syphilis is difficult but important and takes on added significance in the African troops in the British Army, since the prognosis of yaws is favorable but a syphilitic African is a "doubtful risk." The chief differential point is the rapid response of yaws to specific treatment. It is unusual for syphilis to attack the bone and leave the periosteum unscathed, as occurs in yaws, which affects the compacta and involves the periosteum only if the foci are very superficial. Acute osteomyelitis also calls for differentiation, but patients with that disease are much sicker than those with yaws. Tuberculosis usually shows more bone destruction than yaws, but in children the differentiation may be impossible.

SYDNEY J. HAWLEY, M.D.

Radiological Appearances of Bone in Cases of Tropical Ulcer. J. A. Brocklebank. Brit. J. Radiol. **16:** 221–224, August 1943.

Tropical ulcer should not be confused with "tropical sore," which is a manifestation of leishmaniasis. Tropical ulcer is a sloughing ulcer of unknown cause common in the tropics. It may occur anywhere on the body, but is more common on the feet and legs. The course is chronic, continuing for many months, and the disease is resistant to treatment. Ultimate scarring may be severe and deforming. Death sometimes occurs from secondary infection.

About half of the patients show no skeletal changes radiologically. The earliest observed bone change is a periostitis at the ulcer site. This slowly progresses to an osteoperiostitis and ultimately to osteomyelitis.

Differential diagnosis must be made from the bone lesions of syphilis and yaws. This is difficult and may depend finally on the result of treatment.

SYDNEY J. HAWLEY, M.D.

Unusual Osseous Disease with Neurologic Changes: Report of Two Cases. Conrad M. Riley and Harry Shwachman. Am. J. Dis. Child. **66:** 150–154, August 1943.

Two unusual yet similar cases in which bizarre osseous changes and hyperreflexia were outstanding features are presented by the authors in the hope that other cases will be reported and a greater understanding of the condition may be attained. The patients were a girl and a boy, each approximately five years of age. Each had a peculiar gait, which was characterized by a straight leg, a wide base, and a calcaneus limp; neither child could run. Ankle clonus and hyperreflexia were present in both children. One child showed extreme anorexia, with emaciation; the other showed anorexia only. Both were easily fatigued.

Roentgenographic examination of the girl showed alterations in the midportions of all the long bones, with fusiform swelling and areas of relatively increased density and mottled areas of decreased density. There

was generalized poor mineralization, with slight coxa valga deformity of the hips. The skull showed no abnormalities. The bone age was within normal limits. A biopsy of bone and muscle revealed no evidence of an inflammatory process; there was an increase in density of cortical bone and minimal evidence of bone resorption. Some atrophy of the skeletal muscles was noted. This case had been followed at the time of the report for one and one-half years. Later roentgenograms of the long bones showed the change in the shafts to be more pronounced, suggesting a continuation of the process. The deep tendon reflexes were not nearly so active as when the patient was first seen.

In the case of the boy, roentgenograms revealed changes both in the long bones and in the skull. In each femur, beginning about 1 inch proximal to the epiphysis and extending about 4 inches up the shaft, was a smooth fusiform dilatation of the shaft. The bone in this area was of generally increased density, but there were scattered areas of decreased density. There was a valgus deformity of the head of each femur. The tibias and fibulas showed an abnormal area of irregularly thickened cortex at each end of the diaphysis. A similar lesion involved the entire middle part of the shaft of each of the bones of the arm. In the femurs it was also noted that there was a little periosteal reaction over the swellings. The bones at the base of the skull showed a fairly pronounced increase in density. The bony contours, including the foramen magnum, were essentially normal. In the pelvis there was a small, rounded shadow apparently produced by bone and demonstrated by intravenous pyelograms to be outside the genito-urinary tract.

Two Cases of Osteochondral Hypothyroidism. R. Hermon. Brit. J. Radiol. **16:** 208–211, July 1943.

Two cases of osteochondral hypothyroidism are presented. The recent literature covering this condition, Perthes' disease, and other osteochondral dystrophies is reviewed. The contention of Schaefer and Purcell that Perthes' disease is a manifestation of hypothyroidism (Am. J. Surg. **54:** 589, 1941. Abst. in Radiology **39:** 374, 1942) is questioned, and the importance of its differentiation is stressed. Osteochondral hypothyroidism responds readily to thyroid therapy, and if the hypothyroid component is discovered, the treatment period can be shortened and the final results improved. In Perthes' disease, on the other hand, prolonged immobilization may be necessary if deformity is to be avoided.

The value of general skeletal study in all cases is emphasized. In osteochondral hypothyroidism retardation of osseous development is the rule, and apparent bone age is an approximate indication of the severity of the condition. The appearances of the different epiphyses are protean, varying from a slight granular lack of homogeneity to a coarse or fine stippling or fragmentation with or without coherence. The condition is bilateral, usually more or less symmetrically so, and there is often multiple epiphyseal involvement. The changes are most characteristic and usually most marked in the femoral capital epiphyses, where, in addition to the fragmentation, a line of cleavage dividing the epiphyses into inner and outer halves is often observed. This probably represents a pressure splitting of the relatively brittle bony epiphysis. There is a greater tendency to pressure splaying of the diaphyseal extremity of the femoral neck than in Perthes' disease, and in untreated cases the degree of deformity so produced may be extreme. The fragmented epiphysis adapts itself to the altered shape of the femoral neck, but in cases where diaphyseal molding is not marked the epiphysis does not usually show the degree of flattening that is seen in a case of untreated Perthes' disease. SYDNEY J. HAWLEY, M.D.

Pellegrini-Stieda Disease. Morris Reingold and James W. Nellen. U. S. Nav. M. Bull. **41:** 800–811, May 1943.

Eight cases of Pellegrini-Stieda disease are reported. The authors believe that the calcification characteristic of this condition is due to a metaplasia of the soft parts and is not of periosteal origin, since in all of their cases a clear space was demonstrable radiographically between the internal femoral condyle and calcified crescentic mass.

There is a history of trauma in all cases. In the typical case there are no roentgen findings for at least three or four weeks following injury. Subsequently a mottled, fuzzy, indistinct shadow, indicative of recent origin, may appear. A clear-cut, sharply outlined deposit is characteristic of the "stabilized" form.

Treatment is generally unsatisfactory, as pain tends to recur with slight trauma. In 2 of the authors' cases intensive roentgen therapy was used with no apparent effect on the course or symptomatology. Physical therapy produced no demonstrable improvement in 3 additional patients. In 2 cases the disease was discovered when a routine radiographic examination was ordered after the applicants for commission gave a history of severe trauma to the knee but denied any pain or disability since the original injury. In one case the disease was incidental to a traumatized meniscus. ELLWOOD W. GODFREY, M.D.

Significance of Some Developmental Abnormalities of the Hip Joints. Eric Samuel. Brit. J. Radiol. **16:** 250–254, August 1943.

The failure of proper development of the acetabulum in congenital dislocation of the hip is well known. The minor failures and abnormalities of development are less commonly recognized. Their recognition is, however, important both for grading the patient's fitness for military service and because of the frequency with which osteoarthritic changes supervene in later life.

Films should be taken with the patient supine, the medial sides of the balls of the great toes together and the heels two inches apart. Both hips should be included for the sake of comparison.

Congenital subluxation of the hip joint may be recognized as a failure of complete development of the acetabulum, permitting slight displacement of the head of the femur. The acetabulum appears shallow. The lower portion of the joint space is wide and the upper portion narrow. The head appears to be partly out of the socket. There may be an apparent coxa valga, but this is due to rotation of the femur rather than a true deformity. Another type of congenital subluxation is seen when there is a disproportion between the femoral head and acetabular fossa, the latter being too small to accommodate the former. In these cases there is a tendency for the acetabulum to form a false lower lip.

Other deformities that may be recognized are an abnormally deep acetabulum and protrusio acetabuli. Cases of deep acetabula are more common than fully

developed cases of protusio acetabuli, and careful examination of the radiograph is necessary if minor increases in acetabular depth are not to be overlooked. The radiograph shows the femoral head abnormally engaged in the acetabular fossa. These deformities may produce pain on long marching and some limitation of motion. SYDNEY J. HAWLEY, M.D.

Humero-Radial Synostosis. E. Frankel. Brit. J. Surg. **31:** 242–245, January 1944.

Humero-radial synostosis is a rare abnormality occurring in conjunction with other deformities of the limbs. The affected arms are shortened and in the majority of cases the deformity is accompanied by a rudimentary ulna and a faulty development of the carpal bones and fingers. Twenty-two cases have been reported, and in the majority the condition was unilateral. In all cases the humerus continues into the radius without a change in the structure of the bone.

The author's patient was a man aged 23, who had a chronic nephritis and died following a severe suppurative parotitis. He had a bilateral humero-radial synostosis and his elbows were flexed at slightly less than a right angle. There was marked wasting of all the muscles of the arm normally used in movements of the elbow, due to disuse atrophy. The left patella was absent. The right patella was small and on flexion of the knee was displaced laterally over the condyle of the femur. A roentgenogram of the right elbow showed complete absence of the joint space. The ulna was small and was fused with the humerus.

The family history in this case is of particular interest. The patient was one of seven children, four of whom showed the same deformity and abnormalities of the patellae and knee joints. Since neither father nor mother was similarly affected and since recessive hereditary factors appeared not to be involved, the author assumes a germinal change in one of the parents, or at least a germinal re-arrangement, leading to the production of the new characters.

MAX CLIMAN, M.D.

Chronic Osteomyelitis of the Skull. Hans Brunner. Ann. Otol., Rhin. & Laryng. **52:** 850–894, December 1943.

Brunner classifies chronic osteomyelitis of the skull as primary and secondary in type.

The primary type is characterized chiefly by its insidious onset and its slight tendency to spread. An abscess may take from ten days to several months to develop and usually forms a persistent sinus following incision and drainage. Ordinarily, there is minimal fever, no leukocytosis, and little local pain. Spread of the disease process follows the blood vessels, rarely penetrates the dura, and eventually results in sequestrum formation over a period of months or years. Cure is effected by removal of the sequestrum.

When the frontal sinus is involved, abscess formation is extremely slow, with toxemia affecting the nervous and gastro-intestinal tracts; severe headaches develop and there is gradual formation of exostoses. There may be hyperplasia of the nasal mucosa with the presence of nasal polypi and pus. Fistulous tracts may break through from the frontal sinus into the nasal cavity. X-ray examination in chronic sinusitis shows the fuzzy appearing and sclerotic sinus boundaries due to the superficial osteitis. In osteomyelitis, the disease process has passed through the compacta, so that on the roentgenogram the outlines of the sinus not only may be indistinct but may disappear altogether; and due to the thickening of the anterior wall, replacement of the frontal sinus by sclerotic bone occasionally prompts an erroneous report by the radiologist of congenital absence of the sinus. Cases of primary chronic osteomyelitis with involvement of the frontal sinus that progress to fistula and sequestrum formation are best treated by the Riedel operation. Cases with thickening and sclerosis of the walls are a more difficult problem. The clouding seen on the roentgenogram is due to the disease process within the sinus walls, and irrigation is therefore of no value. Operation by the Riedel or Kuhnt technic is worth while for relief of pain and toxemia. The Kuhnt operation usually results in less deformity.

Seven detailed and illustrative case histories are presented with special attention to the operative technic. Etiological factors in this group were erysipelas of the scalp, scarlet fever, head injury, adenocarcinoma of the paranasal sinuses with subsequent obstruction of both naso-frontal ducts, and pansinusitis.

Chronic osteomyelitis of the secondary type is initially an acute osteomyelitis which gradually passes into a chronic phase. There is slow but progressive extension of the process within the bone with marked tendency to spread by way of the blood stream, producing a chronic septicemia and metastatic abscesses. Multiple sequestra frequently form, containing parts of the lamina externa and diploe but usually no lamina interna.

The pathogenesis of the two types of chronic osteomyelitis is essentially the same. Osteoclasis and osteogenesis are both present, the latter predominating, sequestra being formed on the one hand and thickening with sclerosis on the other. In the primary type, the sclerosis is usually found in the frontal sinuses, spreading very gradually peripherally, while in the secondary type, the frontal sinus may clear while sclerosis and sequestra are found in distant parts of the skull such as the vault, malar bone, or wings of the sphenoid.

Treatment of secondary chronic osteomyelitis is very unsatisfactory because of the widespread disease of the bone, the multiple metastases, and the septicemia. The sulfonamides have given some measure of relief. The important point is prevention of the development of acute osteomyelitis into the chronic form.

Infection of the paranasal sinuses was the responsible factor in the 4 cases here presented as typical of the secondary type of chronic osteomyelitis of the skull.

LESTER M. J. FREEDMAN, M.D.

Epidermoid (Squamous Epithelial) Bone Cyst of Phalanx. H. F. Pohlmann and M. Wachstein. Ann. Surg. **119:** 148–154, January 1944.

Only 10 proved cases of epidermoid cyst of the phalanx could be discovered in the literature. In all there was a history of previous injury. Two patients were adolescents and the ages of the others were between twenty-nine and fifty years. The symptoms most often encountered were pain and tenderness with swelling and redness of the part.

The roentgenologic finding is a distinct area of destruction in the terminal phalanx. This translucent area is homogeneous, fairly well circumscribed, and

more or less circular. In one instance the cystic area showed vacuolation and in another two confluent cysts were found. The lesion is usually centrally located, but occasionally may be eccentric. A thin shell of bone may remain or this may be destroyed, with a resultant pathologic fracture.

Enchondroma is the lesion most likely to be confused with an epidermoid bone cyst. Trabeculation of the cystic space with small areas of increased density, when present, is indicative of the former diagnosis. Simple bone cysts occur usually in younger patients (before the age of twenty) and seldom cause symptoms before fracture occurs. They are rare in the phalanges, as are giant-cell tumors.

At operation the picture of epidermoid cyst is characteristic—a white, glistening wall and sebaceous-like contents. Microscopic examination shows the cyst wall to be made up of stratified squamous epithelium. None of the cysts has shown dermal structures.

Treatment may consist of amputation of the phalanx or operative removal of the cyst followed by cauterization of the bony cavity. Operative removal is the method of choice since this preserves the phalanx and may be repeated if there should be a recurrence.

The authors report a case of typical epidermoid cyst in a man of fifty, following injury. A roentgen diagnosis was made and the cyst was removed with subsequent cauterization of the bony cavity.

G. A. CREEL, M.D.

Compound Fronto-Orbital Fractures (Eight Cases). J. Schorstein. Brit. J. Surg. **31:** 221–230, January 1944.

This is a report of 8 cases of compound fracture of the frontal bone with involvement of the frontal and ethmoidal sinuses in 7, the exception being a child, in whom the frontal sinuses had not yet developed. The author is convinced of the necessity for early and extensive operation in these cases, before the development of intracranial infection. All of the patients had scalp wounds containing in their depths the broken fragments of the walls of the paranasal sinuses. Operation was performed in 6 cases and in all of these the dura had been torn and in 4 the brain was severely lacerated. All these patients recovered satisfactorily. The 2 remaining patients were seen ten days and five months, respectively, after the occurrence of the injury, and recovery was delayed and complicated by meningeal sepsis. The disfigurement following these injuries is considerable and bone-grafting should not be too long postponed in uncomplicated cases. Bone grafts were used in 4 of the present series. Detailed case reports with illustrations are included.

The anatomy and mechanism of the injuries are well described. The extent to which the anterior fossa may be pneumatized not only varies within wide limits from case to case, but the right and left halves may present striking differences. In operating on the sinuses from above, the distinction between the posterior parts of the frontal and ethmoidal cavities is difficult to establish, particularly when comminuted fractures have opened both.

Two types of fronto-orbital fractures were seen in this series. In one, the fragments were multiple, irregular, and wedged. In the other, the depressed fragment was large and had the shape of a segment of a circle.

MAX CLIMAN, M.D.

Fractures and Dislocations of the Cervical Spine. F. Crooks and A. N. Birkett. Brit. J. Surg. **31:** 252–265, January 1944.

The authors review a series of 59 cases of cervical spine injury (fractures and dislocations) from hospitals in an industrial area. Industrial accidents accounted for the largest number, with road accidents next in frequency. The cases are classified in groups according to the type of fracture.

Group 1. Spinous Process Fractures: There were 6 cases of fracture of the spinous processes, involving either the 6th or 7th cervical vertebra or both. They are due either to direct violence or to muscle pull.

Group 2. Transverse Process Fractures: There was only one case of transverse process fracture, involving the 7th cervical vertebra.

Group 3. Fractures of the Main Vertebral Substance and Fracture-Dislocations and Dislocations: There were 3 cases of fracture of the atlas in this group. These were isolated fractures and all involved the posterior arch. X-ray evidence showed that union of this type of fracture takes place readily. There were 2 cases of displacement of the atlas on the axis. There was no gross paraplegia in either instance. Fracture of the odontoid occurred in 4 cases, with forward displacement in 3 cases and backward displacement in 1.

The axis was fractured or displaced on the 3rd vertebra in 6 cases. In one of this number there was injury of the cord with Brown-Séquard syndrome and fatal outcome. The ultimate function in the 5 remaining cases was excellent. The author gives a clear description of the anatomical structure at this level with an explanation of the mechanism of this type of fracture.

There were 7 cases of "more or less pure" compression fracture with no cord or root injury. Two cases are described, both of which were caused by diving into shallow water. Each was treated by traction and subsequent plaster collar with good results. Prognosis in compression fractures is excellent. Successful reduction restores normal vertebral contour and the disks are not affected.

There were 10 cases of fracture-dislocations and subluxation, fracture when it occurred being of secondary importance. Permanent injury was done to the soft tissues, disks, ligaments, joints, and muscles. The pathological changes resulting from this type of injury were either synostosis of adjacent vertebral borders or a narrowing of the disk space associated with progressive lipping of the anterior margin of the vertebrae. The functional results in the 8 cases which were traced were good; 2 patients having nerve root lesions at the onset still complained of some pain in the arms after several years. The authors warn of the danger of designating these injuries simply as subluxation on the x-ray evidence.

Dislocation with locking facets occurred in 8 cases. Reduction is attempted by traction of the neck by halter and countertraction on the legs under a general anesthetic. There was a complete paraplegia from the onset in 5 of the authors' series, with fatal outcome, and one death from hypostatic pneumonia.

Injuries to diseased spines are placed in a separate subgroup because of the probability that the bony changes present in the neck must have rendered the patient more vulnerable to injury. There were 12 cases in this group, 10 of which showed changes typical of osteoarthritic spondylitis, while the other 2 exhibited

complete ankylosis as a part of a general ankylosing spondylitis. Only 2 of the 10 patients with osteoarthritic spondylitis showed any displacement of the bones. In some of the cases the radiologists reported no lesion except arthritic changes: yet there were 8 cases of complete or incomplete paraplegia, with 6 deaths. On 2 occasions at postmortem examination a torn disk and ligaments were discovered, allowing fairly complete abnormal displacement of the bones. These cases are difficult from the radiological point of view, for apart from muscle spasm the neck tends to be stiff and is difficult to examine roentgenographically. The level of the injury may be determined alone by the level of the lesion of the spinal cord, but x-ray evidence of co-existing fracture of an isolated spinous process is helpful.

Two examples of fractures in men suffering from late stages of ankylosing spondylitis occurred. In one case the radiographs revealed a fracture through the ossified intervertebral region between the 3rd and 4th cervical vertebrae without displacement. The second case showed complete ankylosis of the spine from axis to sacrum with a fracture in the region of the 7th cervical with gross anterior displacement on the 1st dorsal. In both cases there was an associated paraplegia with fatal outcome. MAX CLIMAN, M.D.

Compression Fractures of the Vertebral Bodies and Other Changes Mistaken for Them. John D. Ellis. J. Bone & Joint Surg. **26:** 139–145, January 1944.

The most frequent site of compression fracture of a vertebral body is the lower thoracic and upper lumbar region, since it is here that the point of greatest pressure occurs and the interspaces are wider than elsewhere.

In the act of flexion, the first part of the motion occurs through the axis of the nucleus pulposus until its resilience is exhausted; the axis of motion is then shifted to the joints of the arches. This mechanism accounts for the compression affecting the entire superior surface of the body, resulting in a wedge-shaped deformity. The greater deformity of the anterior portion of the body is due to the slight amount of anterior motion permitted at the zygapophyseal joints and to the rolling action of the nucleus pulposus. The inferior surface is less often compressed, probably because of the cupping of this surface, permitting the force to be distributed evenly over the surface by the nucleus pulposus.

The determination of compression is made by drawing parallel lines along the superior and inferior surfaces of the vertebral body. In the normal vertebra these should form an angle of 90 degrees with the posterior surface of the body. In compression fractures, the superior surface is affected alone or to a much greater degree than the inferior surface.

The consensus of opinion seems to be that spondylosis and osteophyte formation in the spine do not result from compression fracture of the vertebrae.

Scheuermann's node is a small triangular portion of bone that appears separated from the anterosuperior edge of the vertebral body and is probably due to failure of complete calcification of the cartilaginous end plate. This condition can hardly be confused with fracture. Juvenile osteochondritis of the vertebra or Scheuermann's disease presents a wedging of the vertebral body, but here the superior surface is affected only slightly more than the inferior, the bone edges are irregular, the surfaces of the adjacent bodies are possibly affected, and the location is most commonly in the lower thoracic region.

JOHN B. MCANENY, M.D.

Fractures of the Triquetrum. J. Grant Bonnin and W. P. Greening. Brit. J. Surg. **31:** 278–283, January 1944.

Direct injury to the triquetrum is rare owing to its protection by the overhanging end of the ulna. Indirect injury, however, is relatively common, accounting for 3.5 per cent of all wrist injuries. Two forms may be distinguished: (1) injuries by compression and (2) ligament traction or sprain fractures. Oblique views in addition to the anteroposterior and lateral views are necessary for diagnosis. A slightly oblique view throws the shadow of the triquetrum a little above that of the lunate and allows distinction to be made between the two.

Compression injuries take the form of subperiosteal fractures with little displacement, or areas of depression of cortex and lamellae corresponding to the point of maximal pressure. Associated with compression fractures of the triquetrum are posterior marginal fractures of the radius, with a comminuted fracture of the tubercle and fractures of Colles type with anterior dislocation of the lunate and fracture of the pisiform.

The more common ligament traction fractures occur in excessive palmar flexion, the posterior tubercle of the triquetrum being separated by the pull of the ligaments from the body of the bone. Most frequently the fragment is seen lying parallel with the dorsum of the carpus. The small flake of bone frequently remains ununited and can be seen in the lateral view of the wrist, resembling a sesamoid in the extensor tendons. The organized lower surface of the flake enables it to be distinguished from a recent injury. Avulsion of the tubercle is also seen in association with the less common fracture of the posterior pole of the lunate. In these cases radiographs reveal loss of continuity of the line of the lunate and two lines of compact bone in the avulsed fragment. This fracture may readily be confused with fracture of the tubercle of the triquetrum.

MAX CLIMAN, M.D.

Avulsion Fractures of the Fibula. Morris I. Bierman. U. S. Nav. M. Bull. **41:** 647–652, May 1943.

The differentiation between a simple sprain of the fibular collateral ligaments and chip fracture of the fibular malleolus is important since the latter is indicative of a complete giving way of the ligament at its point of attachment and, unless adequately treated, may result in instability of the ankle joint.

The usual x-ray technic will not demonstrate an avulsion of the fibulocalcanear ligament with tearing off of a small fragment of bone. The author, in addition to the usual anteroposterior and lateral views, recommends a third view. The patient lies prone upon the x-ray table and a sandbag is placed under the ankle. A cardboard film holder is inserted between the foot in plantar flexion and the sandbag (if the film holder extends below the toes no increase in pain is felt). The central ray is directed toward the head at an angle slightly greater than 90° with the dorsum of the foot. The anterior margin of the fibula or point of origin of the anterior and medial fasciculus of the fibular collateral ligament is well demonstrated by this

technic. When a bone fragment is torn off, the rays pass between the fragment and the fibula, and the fracture is easily seen.

ELLWOOD W. GODFREY, M.D.

March Fractures. Baxter L. Clement. J. Bone & Joint Surg. **26:** 148–150, January 1944.

The author examined 32 cases of march fracture in a group of soldiers whose training period averaged eleven weeks.

Routine roentgenograms consisted in anteroposterior and oblique views of the foot. An oblique view was found to be necessary to determine a very early march fracture, the change appearing as a faint nick extending proximally through the cortex of the metatarsal shaft. No transverse fracture line was seen.

The left foot was involved twenty times and the right foot twelve times. Only the second and third metatarsals were affected, the second in 17 cases and the third in 15 cases. About 75 per cent of the fractures were in the distal or middle third of the shaft. In all but 3 cases the fracture line appeared on the medial aspect of the shaft.

On close examination of the cases, the second and third metatarsals were found to be longer than the first metatarsal in all but two instances. It is suggested that this may be a predisposing factor to the occurrence of march fracture, due to the greater weight-bearing falling on the longer bones. It is believed that a metatarsal pad applied at the first complaint of pain, even before a fracture line is evident, will shorten the period of disability. JOHN B. MCANENY, M.D.

March Fracture. Report of a Case Involving Both Fibulae. A. Scott Hamilton and Howard E. Finklestein. J. Bone & Joint Surg. **26:** 146–147, January 1944.

A case of march fracture involving both fibulae, occurring in a soldier, is reported. The authors agree with Camp and McCullough (Radiology **36**: 651, 1941) that this entity probably does not represent a new disease but is simply the response of the weight-bearing skeletal frame to continuous overstrain.

THE GENITO-URINARY TRACT

Renal Cysts, Simple and Otherwise. Wm. F. Braasch and John A. Hendrick. J. Urol. **51:** 1–10, January 1944.

This presentation reviews clinical and therapeutic data in 163 cases seen at the Mayo Clinic in which simple cysts of the kidney were found at operation.

Simple cysts, usually filled with clear serous fluid, are benign and seldom cause clinical complications such as occur with polycystic disease. In the majority of cases, one cyst of relatively large size is present, together with varying numbers of smaller ones. They are often found bilaterally. The presence of a cyst may often be surmised urographically, but the deformity of the renal pelvis frequently presents a problem in differential diagnosis from other renal or extra-renal lesions.

Simple cysts are of clinical significance only when they become large or numerous enough to disturb renal function or when they are discovered upon physical or urographic examination. The usual size of the cyst, in this series, was from 5 to 10 cm. in diameter. The site varies widely. The location was stated in all but 21 of the cases reviewed here. Of those for which the site was given, 23 per cent were in the upper pole, 68 per cent in the lower pole, and about 8 per cent in the central portion of the kidney.

Simple renal cysts are a disease of adult life, 75 per cent of the cases occurring in the fifth, sixth, and seventh decades. Most of the patients suffered no acute pain, but in some there was a dull ache or dragging sensation in the lumbar region or upper abdominal quadrant. Many of the patients were aware of an abdominal tumor, and the authors, upon physical examination, noted its presence in 86 per cent of the cases. Displacement of the kidney, due either to pressure from or weight of the cyst, was noted in 42 cases. Normal renal function tests do not exclude the presence of simple cysts. Hypertension is seldom seen as a direct result of simple renal cyst; it was present in only 3 cases in this series.

Urography, either excretory or retrograde, was performed in all but 13 patients. It offered the best and simplest method of diagnosis. Evidence of deformity was found most frequently in the calices, where details were usually better visualized by retrograde pyelography.

Differentiation of the deformity caused by the simple cyst from that due to a renal or extra-renal neoplasm may often be difficult. Whenever any possibility of a malignant growth exists, the authors believe that the patient should have the benefit of surgical exploration so that an accurate diagnosis can be reached. Aspiration of cysts for diagnosis is usually unsatisfactory.

Other types of renal cyst mentioned in this paper are the multilocular, peripelvic, and parapelvic. The first is nothing more than a large cyst subdivided by numerous partitions. Peripelvic cysts may be directly connected with the renal pelvis and some cause recurring pain due to secondary infection, with eventual stone formation. Parapelvic cysts are situated adjacent to the renal pelvis; they may be of congenital or perirenal lymphatic origin. NATHAN P. SALNER, M.D.

Post Caval Ureter. Carl L. Wilson and Jacob Herzlich. J. Urol. **51:** 14–18, January 1944.

The authors report a case of retrocaval ureter found at operation. Medical literature records only 27 examples of this anomaly. Preoperative diagnosis was made in only one instance. Present opinion states that the fault lies in the abnormal embryologic development of the inferior vena cava. The right post-cardinal vein in failing to atrophy, as it usually does, forms the main channel from which the inferior vena cava develops. As a result the right ureter is forced to pass behind this vessel. There is nothing characteristic about the patient's complaints.

The authors' patient, a 21-year-old male, had intermittent attacks of right renal colic occasionally associated with the appearance of bloody urine. With time these attacks increased in severity and frequency. Physical examination was negative except for mild costovertebral tenderness on the right. Routine blood and urine studies were essentially normal. On cystoscopy the bladder appeared normal, and catheters could be passed up each ureter without difficulty. Flow from the left kidney was normal, while that from the right was poor. An indigo carmine test showed function to be good on the left and definitely diminished on the right.

Retrograde pyelography revealed a normal left kidney and ureter. The right kidney was found to be hydronephrotic and the upper right ureter was greatly dilated. Films taken with a ureteral catheter in place showed the ureter to be displaced mesially and situated over the vertebrae for a good part of its extent, forming a pronounced "hook" at the level of the third lumbar vertebra. No cause could be determined for this picture preoperatively. Upon operation it was seen that the right ureter was situated retrocavally and was being compressed by the vena cava.

The x-ray findings in this condition—medial ureteral displacement and the characteristic "hooking"—form a picture that is quite different from that seen in any other form of ureteral obstruction.

NATHAN P. SALNER, M.D.

Management of Bilateral Ureteral Obstruction. Theodore R. Fetter. Pennsylvania M. J. **47:** 345–356, January 1944.

With the aid of intravenous or excretion urography the radiologist is often the first to report the true nature of obstructive disease in the urinary tract. For successful excretion urography, however, adequate renal function is essential. If phenolsulfonphthalein elimination is found to be less than 25 per cent of normal, intravenous pyelography is contraindicated.

Bilateral ureteral obstruction is a serious condition and continued observation of the urinary tract is necessary even though the obstruction is removed.

Congenital anomalies are relatively common in the genito-urinary tract, and pyuria in children, tending to recur, should suggest congenital obstruction.

Obstruction due to stricture may progress silently until the patient becomes mildly uremic. Pus in the urine is a rather constant factor. Upper ureteral strictures are usually congenital. Those in the lower ureter are more commonly acquired.

Ureteral stones and tuberculosis of the urinary tract are not uncommon causes of bilateral ureteral obstruction.

Pregnancy may cause bilateral obstruction and is usually most marked on the right side. Bilateral drainage usually controls the condition.

Illustrative cases are reported, including one of stricture due to the effects of radiotherapy for a cervical carcinoma. JOSEPH T. DANZER, M.D.

Course of the Prostatic Ducts and the Anatomy, Chemical and X-Ray Diffraction Analysis of Prostatic Calculi. Charles Huggins and Richard S. Bear. J. Urol. **51:** 37–47, January 1944.

The authors' aim is to show that true prostatic calculi have nearly constant chemical composition and that they often accumulate in prostatic ducts. True prostatic calculi are defined as those which are endogenous, in the substance of the gland, and derived from prostatic secretions.

In prostates removed whole, calculi were located posteriorly and peripherally. Sections showed the largest calculi to be within the ducts, while the acini contained merely microscopic stones. The stone-filled ducts are seen roentgenographically running between the lateral lobes and the posterior lobe to approach the mid-line in a crescentic course. Most of the ducts empty lateral to the verumontanum; some through its convex surface, and a few into the utriculus. Calculi present in the stroma, the authors believe, have sloughed through the epithelium.

The chemical composition of prostatic calculi varies over a narrow range. Organic components constitute about 20 per cent and include protein (8 per cent), cholesterol (3.7–10.6 per cent), and citrate (0.17–2.9 per cent). Tertiary calcium phosphate, $Ca_3(PO_4)_2$, is the principal inorganic constituent. Carbonate is somewhat less than in bone. However, chemical and x-ray analyses reveal close similarity of the inorganic constituents of prostatic calculi and bone salt.

STUART P. BARDEN, M.D.

THE VASCULAR SYSTEM

Primary Thrombosis of the Axillary Vein Due to Strain. Samuel J. Stabins. U. S. Nav. M. Bull. **41:** 1106–1114, July 1943.

A presumptive diagnosis of primary thrombosis of the axillary vein is warranted when a patient, not acutely ill, gives a history of prolonged effort or sudden strain, followed in a few hours by dull pain in the armpit and subsequent swelling of the arm. The skin is bluish or bluish purple and numerous dilated superficial veins are seen about the pectorial region and mid axilla. The use of a radiopaque dye intravenously to determine the site of obstruction and adequacy or inadequacy of the collateral circulation is a safe and important test. In the case recorded here, 30 c.c. of contrast material was injected in each arm in 20 seconds. Films are exposed 15 seconds after beginning the injection and again 2 minutes after injection is completed, at which time no dye is visualized if the collateral circulation is adequate.

There are three schools of thought relative to treatment, favoring, respectively, (1) immediate surgery with ligation, or ligation and resection of the thrombosed segment; (2) conservative handling without any surgery; (3) early conservative treatment, with later removal of the thrombosed segment. The author favors the third method.

ELLWOOD W. GODFREY, M.D.

RADIOTHERAPY

NEOPLASMS

Roentgen Therapy for Bronchiogenic Cancer. Bernard Pierre Widmann. Am. J. Roentgenol. **51:** 61–68, January 1944.

A review of the literature indicates that primary bronchiogenic cancer has increased in incidence at an accelerating rate, now constituting about 10 per cent of all cancers. The longevity cycle of 167 irradiated cases of this disease was compared with another series of 119 cases which received no treatment. All were proved microscopically. Unfortunately, the majority of the cases are advanced and inoperable when a clinical, roentgenologic, or bronchoscopic diagnosis is made.

The technical irradiation procedure varied considerably. The voltage was the same throughout, 200 kv. The filtration was almost always 0.5 mm. of copper, but in some cases 2.0 mm. of copper was used. The target

skin distance was uniformly 50 cm. Treatments were usually given every second day. The majority of the cases were treated through one anterior chest field and one posterior chest field. The size of the fields varied. The dose never exceeded 200 r given to each of two, three, four, and occasionally more fields on the same day at the rate of three treatments a week. The tissue dose at the approximate tumor level was 2,500 r in the majority of cases. The predetermined plan of dosage was usually 3,500 r, but treatments frequently were discontinued because of failing health and strength. More than half of the treated cases received in excess of 2,500 r. This experience revealed that the skin and physical tolerance may permit total doses of 8,000 r, 10,000 r, and 12,000 r. Any treatment that exceeded 2,500 r represented the total dosage of two, three, or four series given at six-, eight-, and twelve-week intervals.

In this study the value of irradiation was considered according to the life cycle from the time of instituting roentgen treatment, which was practically always within a few days of making the diagnosis. Of the 119 untreated patients none lived a year after the diagnosis was made; 112, or 94 per cent, lived less than six months. Of the 167 treated patients, 18 lived twelve months or more from the time of making the diagnosis; 2 lived two years; 1 lived three years; 1 lived five years, and 1 is still alive after six years. Eighty-nine per cent lived less than one year; 67 per cent lived less than six months. All of those living two years or more received in excess of 6,000 tissue roentgens. Many patients lived less than one year after total doses of 5,000 to 13,000 r.

The cellular character of the tumor seems to bear little relationship to the response to irradiation. Prognosis was poor in this series of 286 cases of bronchiogenic cancer because of the advanced stage of the disease at which a correct diagnosis was made. Since no patient who was not irradiated survived longer than a year, and since 18 patients who were irradiated lived one to six years, the value of roentgen therapy as a palliative procedure in this disease seems unquestionable. Every patient, therefore, except the few who may be considered operable, should have the benefit of irradiation. CLARENCE E. WEAVER, M.D.

Three and One-Half Years' Experience with the 1,000 Kilovolt Roentgen Therapy Unit at Memorial Hospital. Alfred F. Hocker and Ruth J. Guttman. Am. J. Roentgenol. **51:** 83–94, January 1944.

This paper is based on the results obtained in 315 patients with cancer who were treated by a 1,000,000-volt machine. A description of the machine is given. Transformer and tube are contained in a grounded steel tank. The roentgen rays are generated from a target mounted in the end of an extension chamber projecting out from the bottom of the grounded tank. The unit is free from exposed high voltage. It has been made flexible and can be adjusted to the patient. This is especially important when small beams are used, as they are in the higher-voltage unit, because of the relatively larger gain in depth dose. An integrating and recording dosimeter provides a graphic record of each treatment. The following factors are used: a tube current of 3 ma.; a filter consisting of 2 mm. tungsten, 2 mm. mercury, 8 mm. copper, and several mm. of water. These form a half-layer value of 3.8 mm. of lead. The target skin distance is 70 cm. The intensity of the vertical beam is 50 r per minute.

Of 315 patients, 170 were classified as suitable for use as a means of judging the value of the treatment. The treatments were given in daily fractional doses of 250 to 400 r, measured in air. As a rule, they were better tolerated than 200,000-volt treatments by similar patients. Roentgen sickness was not even a problem. With few exceptions the skin reaction from a total dose ranging from 2,100 to 5,000 r per portal was not severe.

Of a total of 315 patients, 213 are dead. In 145 patients palliation was all that could be expected. Some of the 170 suitable cases that remain, if these are eliminated, had already been treated up to the skin tolerance by the 200,000-volt unit and some were so sick that the course of treatments had to be stopped before a satisfactory amount of radiation could be given.

Physical measurements show that at greater depth the higher voltage does deliver a larger dose than is possible with the lower unit. This is particularly true when smaller fields are used. The dose on the surface of exit, however, somewhat offsets the practical value of the greater depth dose. The million-volt unit permits the use of a small field so that less normal tissue is included in the irradiated area.

The present analysis would seem to indicate, however, that the million-volt machine is not a substitute for the 200,000-volt unit; that its use is limited to the treatment of deep-seated tumors. At a depth of 7 or 8 cm., the lower-voltage unit gives nearly as great a dose as the higher-voltage unit, and since the former is a more flexible machine, it is better to use it in the treatment of tumors within that range.

Tables are given showing the survival rate in cancer in various locations of the body after treatment with the million-volt machine.

CLARENCE E. WEAVER, M.D.

NON-NEOPLASTIC DISEASE

Radiation Therapy for Obstructing Tuberculous Hilar Lymph Nodes. Kal Freireich. Am. Rev. Tuberc. **49:** 31–37, January 1944.

The author reports a case of primary tuberculosis occurring in a seventeen-year-old colored girl who had progressive bronchial obstruction as a result of compression by enlarged tracheobronchial lymph nodes. In spite of general supportive treatment and bed rest, the symptoms became more and more severe, with increasing dyspnea and wheezing. The patient was then given a series of x-ray treatments at weekly intervals, a total of six being given. Each treatment consisted of 112 r at 200 kv., with 0.5-mm. copper filter. Treatments were alternated between the anterior and posterior mediastinum, so that a total of 336 r was given to either side. The symptomatic result was dramatic. After the first treatment was administered, the patient noted diminution in wheezing. Both dyspnea and wheezing had completely disappeared after the third treatment, and the patient was much relieved. No adverse effects on the pulmonary tuberculosis were demonstrated, either symptomatically or on roentgenographic study. It is concluded that radiation therapy for mediastinal tuberculous lymph nodes seems to be a safe procedure when used in consultation with a skilled radiation therapist. L. W. PAUL, M.D.

EFFECTS OF RADIATION

Clinical Study of the Results of Exposure of Laboratory Personnel to Radar and High Frequency Radio. L. Eugene Daily. U. S. Nav. M. Bull. **41:** 1052–1056, July 1943.

Observation of 45 civilian employees connected with the experimental radar work at the Naval Research Laboratory convinced the author that there was no clinical evidence of damage to the personnel.

The duration of exposure varied from 2 months to 9 years. Periodic blood counts and physical examinations over a 12-month period were within the normal range. There was no abnormal or premature alopecia, nor were there any unusual dermatologic manifestations. There was no evidence of damage to the reproductive tissues, as judged by the number of conceptions and normal pregnancies during the time of exposure of the fathers to radar.

With the machines operating at peak load there is an area of radio frequency within 3 or 4 feet of a transmitter or antenna. Occasionally a flushed feeling of the face or hands was noted when these were placed directly in the field. A frontal headache sometimes developed after some hours of exposure but disappeared spontaneously in one-half hour to an hour.

ELLWOOD W. GODFREY, M.D.

Abnormal Pulmonary Physiology as a Result of Chronic Irradiation Pleuropulmonitis: John E. Leach. Am. J. Roentgenol. **50:** 772–778, December 1943.

Seventeen patients with different degrees of chronic irradiation fibrosis of the lung were subjected to various tests of pulmonary and circulatory function. Comparison of the results with those obtained from a group of normal persons and patients with other pulmonary disorders, as emphysema, pneumothorax, etc., indicates that chronic irradiation pleuropulmonitis is really a disturbance of the entire thorax, resulting in fixation of a portion of the thoracic parietal structures, fibrosis of the pleura and lung parenchyma due to irradiation, a secondary alveolar fibrosis beyond the irradiated area, mediastinal fibrosis with partial fixation of the lung hilum, structural changes in the wall and mucosa of the large bronchi, partial immobilization of the diaphragm, and some degree of compensatory emphysema of the untreated side.

The most disabling feature is the severe dyspnea that may follow ordinary exercise. Many of these patients are obese and this alone induces greater ventilation reflexly and reduces the maximum ventilation capacity mechanically. Additionally, the relationship between the ventilation per minute and the maximum ventilatory capacity is markedly changed in the presence of irradiation pleuropulmonitis. L. W. PAUL, M.D.

EXPERIMENTAL STUDIES

Absorption of Radioactive Sodium Instilled into the Vagina. W. T. Pommerenke and P. F. Hahn. Am. J. Obst. & Gynec. **46:** 853–855, December 1943.

In a study of the absorptive properties of the vaginal tissues, the authors used a solution containing radioactive sodium. This was introduced into the vaginas of 7 women and observations were made in normal subjects, following subtotal hysterectomy, post partum, and in one patient with threatened abortion. The amount of salt instilled ranged from 105 to 150 mg., about 10 c.c. of solution being used in each instance. Blood samples taken at different intervals thereafter were examined with the aid of a Geiger-Müller counter for radioactivity.

Wide fluctuations were observed in the amounts of sodium absorbed—from 0.2 after an interval of thirty minutes in a normal subject to 11.5 after eighteen hours in a patient twelve days post partum. No parallelism was noted between the amount instilled and that recovered from the blood. The greatest percentage of absorption occurred in women who had recently been delivered or whose vaginas and cervices had been variously traumatized. It thus appears that the clinical condition of the vaginal wall and/or cervix may be the important determining factor which controls the amount of absorption.

These experiments suggest the need for special caution in administering douches containing poisonous ingredients, particularly when the vagina and/or cervix have been recently traumatized.

STEPHEN N. TAGER, M.D.

Influence of Irradiation-Killed Cells on Tumor Growth. Paul S. Henshaw. J. Nat. Cancer Inst. **4:** 305–307, December 1943.

Although it seems certain that the direct action of irradiation destroys tumor tissue, it is probable, also, that indirect effects of irradiation play a role in tumor regression, since (1) tumor cells *in vitro* are more resistant to irradiation than those *in vivo*, (2) tumor cells transplanted to an irradiated area are less likely to grow than when transplanted to a non-irradiated area, and (3) irradiated tumor cells undergoing regression will grow and kill the host if transplanted to a new area. Three possible types of indirect action may be: (1) damage to the local vascular system altering tumor metabolism; (2) changes in the stroma and malignant cells followed by leukocytic infiltration, fibrosis, and encapsulation; (3) production of toxic tissue products (necrotoxins) from destroyed cells.

Three experiments were carried out to test the last named hypothesis of necrotoxic effect. Macerated tumor tissue (mouse sarcoma 37) was given a lethal dose of 5,000 r in 25 minutes. This was then mixed with unirradiated tumor pulp in the proportions of 25 to 75 per cent, 50 to 50 per cent, and 75 to 25 per cent, and injected in mice, 10 animals being used for each mixture. Rapidly growing tumors were obtained in all the animals. In a second experiment the irradiated tumor pulp was injected subcutaneously around growing tumors in such a manner that the tumor was surrounded by a ring of dead tumor pulp three to four times its size. No retarding effect was observed. In the third experiment, tumors *in vivo*, 10 to 15 mm. in diameter, were subjected to a dose of 5,000 r, the remainder of the host being effectively shielded. Viable tumor tissue was then injected into the treated site. The usual slough with ulceration occurred in the expected time but the tumor invariably recurred.

It may be concluded, therefore, that so far as the material tested is concerned, irradiation-killed cells or their decomposition products exert no inhibitory influence on the growth potentiality of viable tumor cells. LESTER M. J. FREEDMAN, M.D.